U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-259 497

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO, DES PLAINES, O'HARE WATER RECLAMATION PLANT AND SOLIDS PIPELINE

VOLUME II. APPENDICES

ENVIRONMENTAL PROTECTION AGENCY,
CHICAGO, ILLINOIS

MAY 1975

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PB 259 497

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

O'HARE WATER RECLAMATION PLANT AND SOLIDS PIPELINE

FINAL VOL. II

ENVIRONMENTAL IMPACT STATEMENT

MAY 1975

Prepared by:
US ENVIRONMENTAL PROTECTION AGENCY
REGION V
Chicago, Illinois

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U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

FINAL ENVIRONMENTAL IMPACT STATEMENT
FOR THE
METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
DES PLAINES - O'HARE WATER RECLAMATION PLANT
AND SOLIDS PIPELINE

PREPARED BY THE
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION V
CHICAGO, ILLINOIS

VOLUME II

APPENDICES

MAY 1975

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APPENDIX A

O'Hare Area Flood Control Activities

Design Criteria

Wilke-Kirchoff Reservoir, Project 70-407-2F
Heritage Park Reservoir, Project 68-815-2F
White Pine Ditch Retention Reservoir, Project 72-313-2F
Buffalo Creek Retention Reservoir, Project 67-803-2F
Willow Higgins Retention Reservoir, Project 68-836-2F
Mount Prospect Retention Reservoir, Project 69-308-2F

WILKE-KIRCHOFF RESERVOIR, PROJECT 70-407-2F

The Wilke-Kirchoff Reservoir is a multi-purpose excavated floodwater retarding, pump evacuated reservoir constructed by the Metropolitan Sanitary District of Greater Chicago, in cooperation with the Village of Arlington Heights, at a cost of $871,000. The reservoir occupies a 16 acre site, is 12 feet deep, and has a storage capacity of 100 acre-feet. It serves a 717 acre tributary area and is designed to accommodate a 100 year storm.

The Wilke-Kirchoff Reservoir is located south of Kirchoff Road, and east of Wilke Road in the Village of Arlington Heights.

The reservoir was designed to serve as a recreational facility, in addition to its primary function of reducing local flooding. Possible winter activities include tobogganing and skiing on a large earth mound in one corner of the reservoir formed with excavated material. Summer activities can include such things as volleyball, basketball, baseball, soccer, football, and a general play area. All recreational activities are supervised by the Arlington Heights Park District.

The reservoir is excavated in a clay soil. The side slopes are 7:1, providing easy access to the bottom of the reservoir for recreational usage. The bottom and side slopes are sodded to prevent erosion and to present an esthetically attractive appearance.

A pumping station, located at the northwest corner of the site contains three variable speed pumps with a capacity of 6.67 cfs to 12 cfs and two low flow pumps with a capacity of 0.33 cfs. These pumps can empty a full reservoir in 6 days. Most storms, however, will not fill the reservoir completely, and the dewatering time will be less than 6 days. An underdrain system is provided beneath the reservoir floor to remove the excess ground and storm water and thereby provide maximum recreational usage of the reservoir bottom.

Storm sewers draining the tributary area carry the runoff into the reservoir through two inlet structures. At low flows, the runoff drops through a grate in the inlet structures and is conveyed to the pumping station through the reservoir dewatering system. The multi-purpose use of the reservoir is enhanced by use of the low flow bypass system. The water from the reservoir is pumped through a 30 inch force main to a storm sewer that discharges into Weller Creek, the natural drainage outlet for the reservoir tributary area.

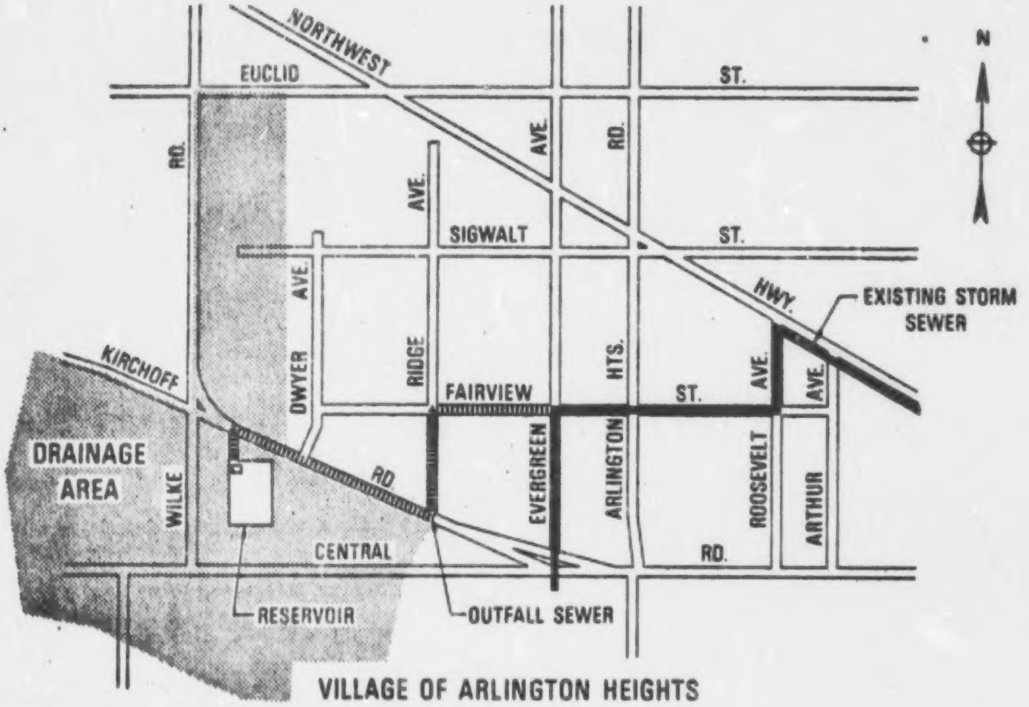
Construction of the reservoir began in August 1972, and was completed in the fall of 1973. The Metropolitan Sanitary District contributed $736,000 of the construction cost and the Village of Arlington Heights contributed $135,000. In addition, the Village of Arlington

Heights paid $195,000 to acquire the reservoir site and also assumed the engineering design costs. The Village will be responsible for the operation and maintenance of the facilities.

SHEET 1 OF 2

WILKE - KIRCHOFF RETENTION RESERVOIR
RESERVOIR - PROJECT NO. 70-407-2F
OUTFALL SEWER - PROJECT NO. 71-310-2F

DRAINAGE AREA	717 ACRES
DESIGN STORM	100 YR.
PUMPING STA. CAPACITY	36.7 c.f.s.
CONSTRUCTION COMPLETED	
CONSTRUCTION COSTS	$ 871,000
LAND AREA	14.6 ACRES
LAND COST	$ 232,000

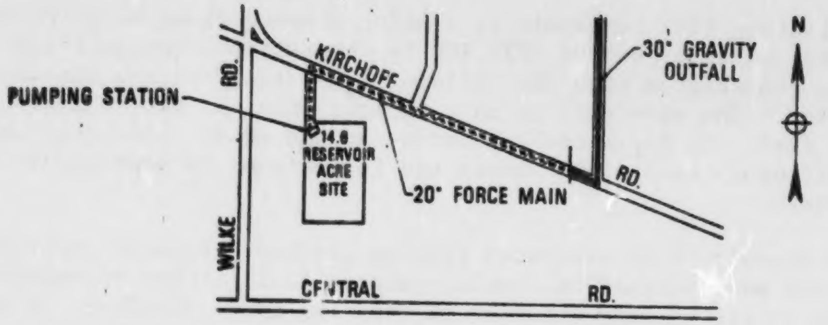

NORTHWEST
HWY.
EUCLID
ST.
SIGWALT
ST.
FAIRVIEW
ST.
CENTRAL
RD.
KIRCHOFF
RD
WILKE
RD.
DWYER
AVE.
RIDGE
AVE.
EVERGREEN
AVE.
ARLINGTON
HTS.
RD.
ROOSEVELT
AVE.
ARTHUR
AVE.
N
EXISTING STORM SEWER
DRAINAGE AREA
RESERVOIR
OUTFALL SEWER
VILLAGE OF ARLINGTON HEIGHTS

LOCATION MAP

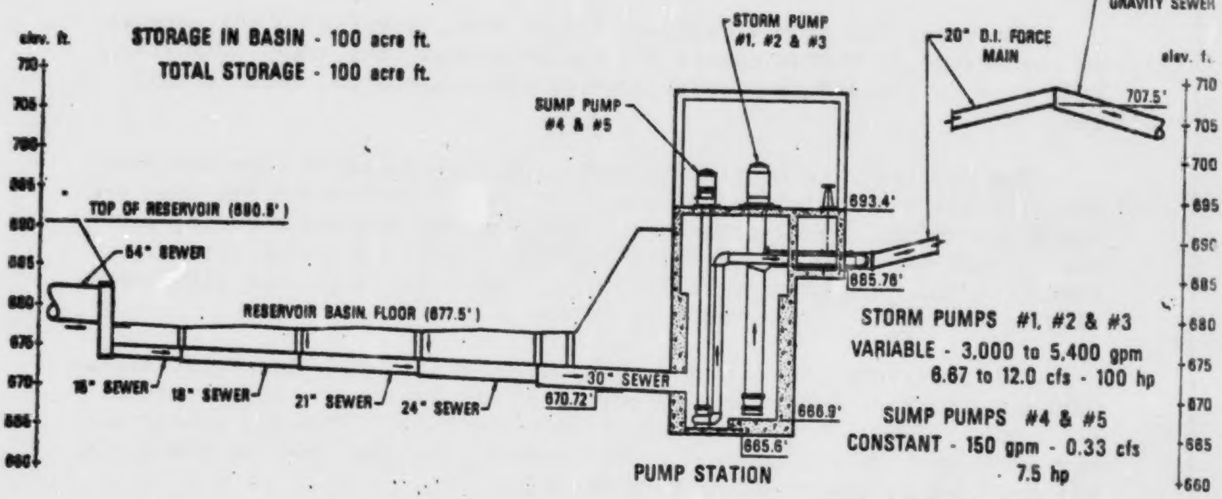
METROPOLITAN SANITARY DISTRICT
OF GREATER CHICAGO
FLOOD CONTROL SECTION
JAN. 1973

WILKE - KIRCHOFF RETENTION RESERVOIR
RESERVOIR - PROJECT NO. 70-407-2F
OUTFALL SEWER - PROJECT NO. 71-310-2F

SHEET 2 OF 2


KIRCHOFF
RD.
WILKE
RD.
CENTRAL
RD.
PUMPING STATION
14.8 RESERVOIR ACRE SITE
20" FORCE MAIN
30" GRAVITY OUTFALL
N

RESERVOIR LAYOUT


elev. ft.
710
705
700
695
690
685
680
675
670
665
660
TOP OF RESERVOIR (690.5')
54" SEWER
RESERVOIR BASIN FLOOR (677.5')
15" SEWER
18" SEWER
21" SEWER
24" SEWER
30" SEWER
670.72'
SUMP PUMP #4 & #5
STORM PUMP #1, #2 & #3
693.4'
685.76'
666.9'
665.6'
PUMP STATION
20" D.I. FORCE MAIN
30" R.C.P. GRAVITY SEWER
707.5'
elev. ft.

STORAGE IN BASIN - 100 acre ft.
TOTAL STORAGE - 100 acre ft.

STORM PUMPS #1, #2 & #3
VARIABLE - 3,000 to 5,400 gpm
6.67 to 12.0 cfs - 100 hp

SUMP PUMPS #4 & #5
CONSTANT - 150 gpm - 0.33 cfs
7.5 hp

TOTAL PUMP CAPACITY - 16,500 gpm
36.7 cfs

OVERFLOW @ 689.5' elev.

PUMP CONTROLS - SPARLING - FLOAT

PROFILE

METROPOLITAN SANITARY DISTRICT
OF GREATER CHICAGO
FLOOD CONTROL SECTION
JAN. 1973

HERITAGE PARK RESERVOIR, PROJECT 68-815-2F

The Heritage Park Reservoir is a multi-purpose flood water reservoir constructed at a cost of $270,000 by the Metropolitan Sanitary District in cooperation with the Village of Wheeling and the Wheeling Park District. The reservoir is on a 25 acre site and has an average depth of 5 feet. It has a usable storage volume of 112 acre-feet which serves a tributary area of 447 acres and is designed to accommodate a 100 year storm.

The reservoir is an excavated storage gravity discharge structure. The reservoir was designed as a multi-purpose facility for recreation, in addition to its primary function of reducing local flooding. A permanent lake, about 8 acres in area and 5 feet deep, is provided to enhance the recreational features of the reservoir and usage for winter activities. Tobogganing and skiing utilize a large earthen hill constructed east of the reservoir with material excavated from the reservoir. The adjacent park areas are utilized for all other seasonal activities. Recreational activities are supervised by the Wheeling Park District.

The reservoir side slopes are 4:1 or less, permitting easy access to the reservoir bottom except for the permanent lake area. The reservoir area is grassed to prevent erosion and enhance the recreational use.

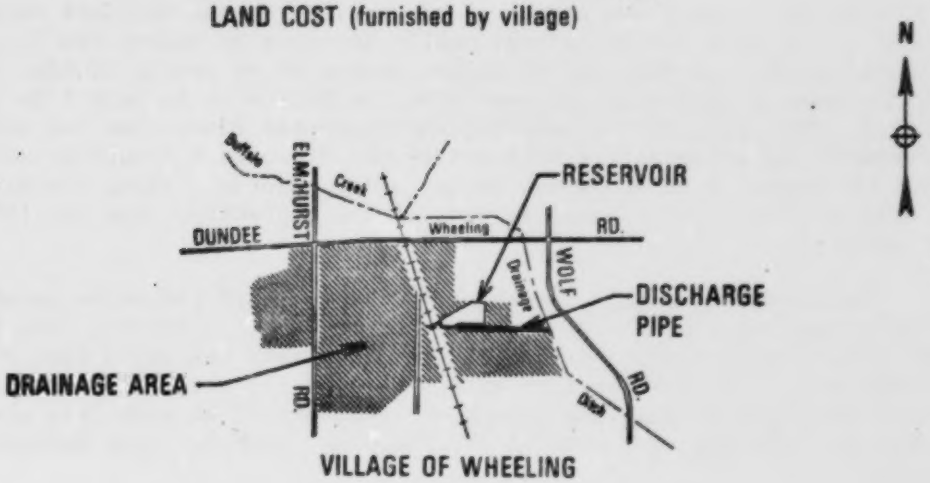
The reservoir is emptied through a 60 inch diameter pipe into the Wheeling Drainage Ditch. A flap gate on the 60 inch discharge pipe prevents water from the drainage ditch entering the reservoir during periods of high water in the Wheeling Drainage Ditch. The flap gate also restricts the flow of storm water out of the reservoir until flow capacity is available in the Wheeling Drainage Ditch.

The reservoir construction was completed in 1970. The Metropolitan Sanitary District contributed $180,000 of the facility's construction cost and the Village of Wheeling contributed $90,000 for the construction and paid the engineering design costs. The land for the reservoir was provided by the Wheeling Park District.

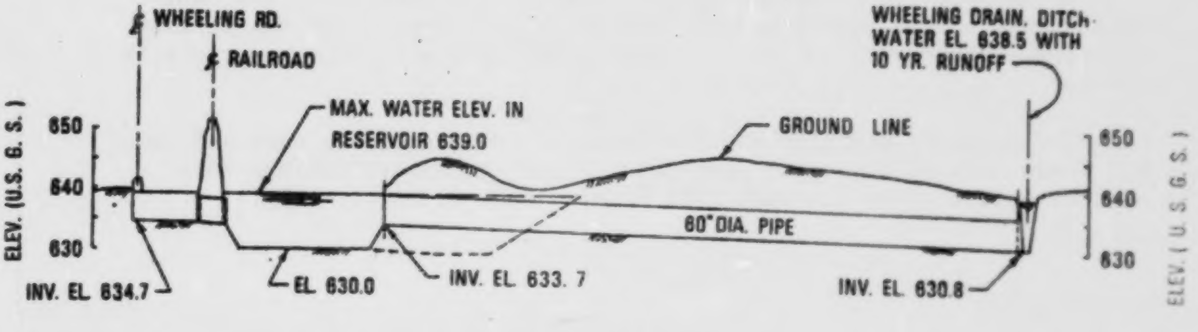
HERITAGE PARK WEST RETENTION RESERVOIR

PROJECT NO. 68-815-2F

DRAINAGE AREA	447 ACRES
DESIGN STORM	100 YEARS
PUMPING STA. CAPACITY	NONE
CONSTRUCTION COMPLETED	2-16-70
CONSTRUCTION COSTS	$270,000 TOTAL (M.S.D. PAID 67%)
LAND AREA	25 ACRES
LAND COST (furnished by village)	


N
Buffalo
Creek
ELMHURST
RD.
DUNDEE
Wheeling
RD.
WOLF
RD.
Drainage
Ditch
RESERVOIR
DISCHARGE PIPE
DRAINAGE AREA
VILLAGE OF WHEELING

LOCATION MAP


℄ WHEELING RD.
℄ RAILROAD
WHEELING DRAIN. DITCH WATER EL. 638.5 WITH 10 YR. RUNOFF
MAX. WATER ELEV. IN RESERVOIR 639.0
GROUND LINE
ELEV. (U.S. G. S.)
650
640
630
60" DIA. PIPE
INV. EL. 634.7
EL. 630.0
INV. EL. 633. 7
INV. EL. 630.8
ELEV. (U. S. G. S.)
650
640
630

PROFILE

METROPOLITAN SANITARY DISTRICT
OF GREATER CHICAGO

FLOOD CONTROL SECTION

'09 R. G.H.G. UGUST, 19

WHITE PINE DITCH RETENTION RESERVOIR, CONTRACT NO. 72-313-2F

The White Pine Ditch Retention Reservoir is a project of inter-agency cooperation that will divert flow from the White Pine Ditch Watershed to control chronic overbank flooding and sanitary sewer back-up caused by storm flows entering and overloading the sanitary sewer system. The need for additional public services to assist people in flooded areas, and the loss of direct access to or around flooded areas with emergency equipment, is costly to the habitants in both life and assets. Diversion of the existing and increased flows from the road improvement and urbanization will convey the flows to a reservoir site with the capacity to store the excess storm runoffs. Along the water-course no site could adequately provide the protection from the 100-year storm event.

The Dundee Road improvement project, developed and under construction by the Department of Transportation, State of Illinois, includes the larger sized storm sewer to divert flows from the White Pine Ditch to the east. The discharge of this sewer and the naturally contributing areas are directed into the retention reservoir of 50 acre-feet storage capacity. The reservoir and White Pine both discharge into Buffalo Creek.

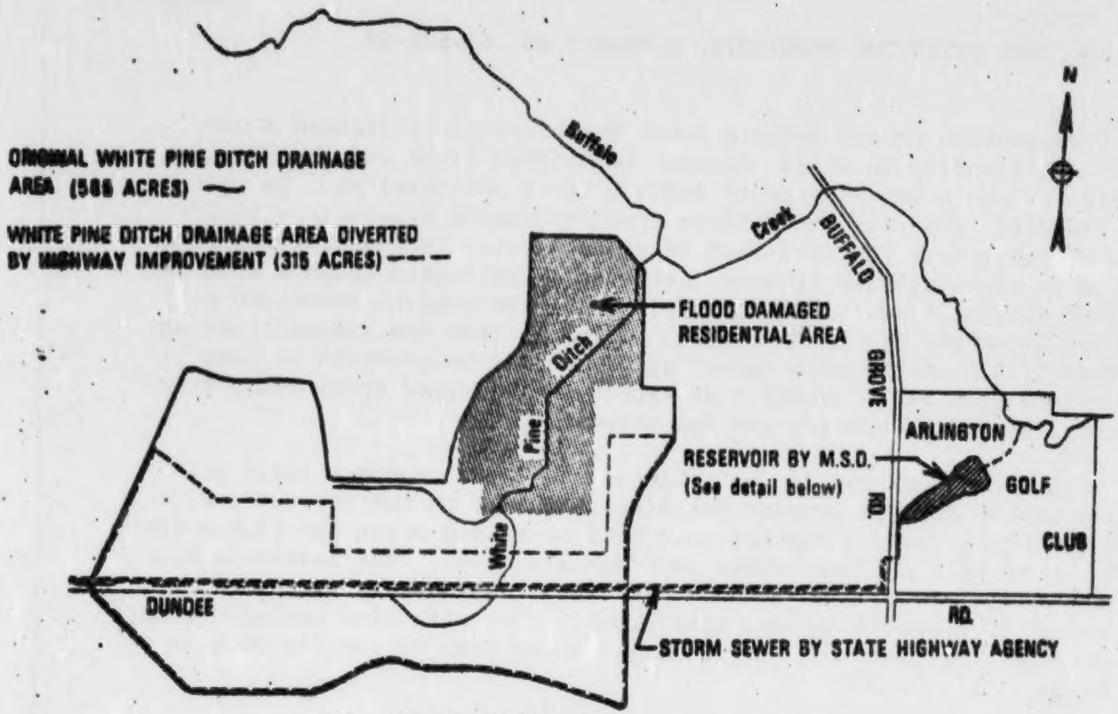
The Village of Buffalo Grove reported the monetary flood related losses for the year 1972 to be $50,700. These losses for the White Pine Ditch area only involved 119 homes.

Cost involvement for the reservoir project are as follows: $120,000 from the Metropolitan Sanitary District, $130,000 from the Department of Transportation of the State of Illinois, and any additional cost by the Village of Buffalo Grove.

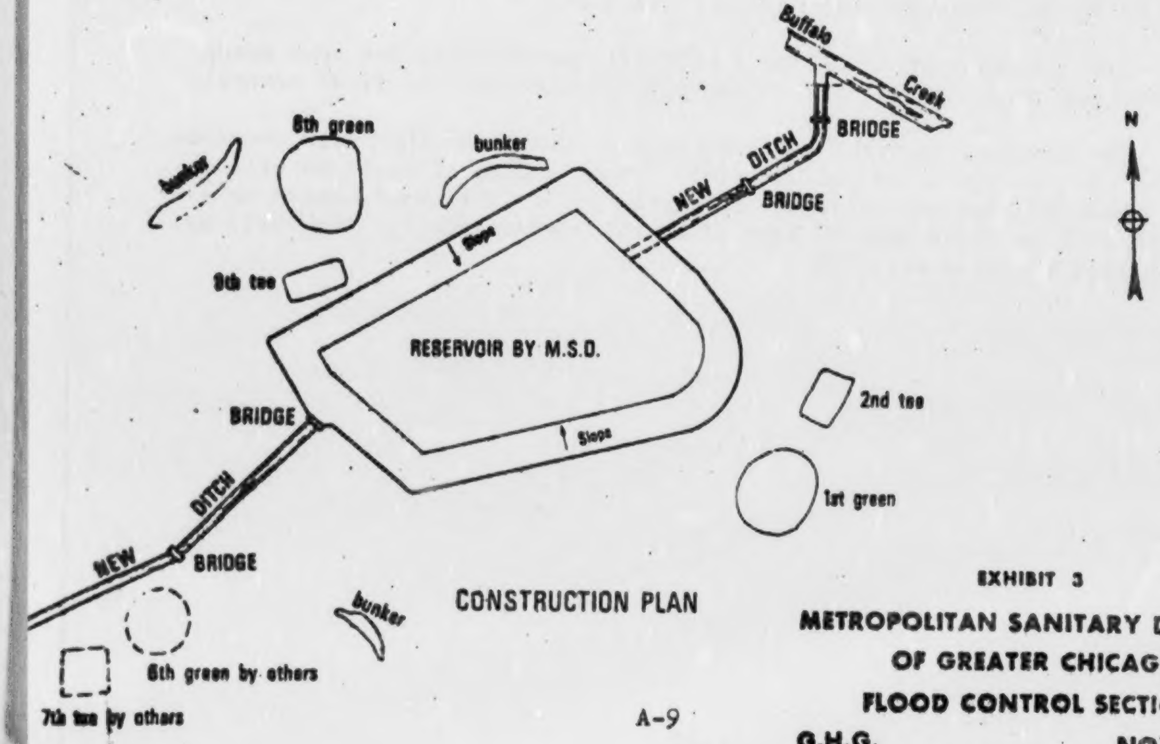
In addition to the construction cost for the reservoir, the Sanitary District will administer the construction contract and the Village of Buffalo Grove will secure the land rights upon which the reservoir is located.

The Sanitary District has authority to undertake this work and commit funds without a general election. Plans and specifications were awarded August 8, 1974. Work will be completed by May 1, 1975.

WHITE PINE DITCH RESERVOIR


ORIGINAL WHITE PINE DITCH DRAINAGE AREA (566 ACRES)
WHITE PINE DITCH DRAINAGE AREA DIVERTED BY HIGHWAY IMPROVEMENT (315 ACRES)
N
Buffalo
Creek
BUFFALO
GROVE
RD.
FLOOD DAMAGED RESIDENTIAL AREA
White Pine Ditch
ARLINGTON
GOLF
CLUB
RESERVOIR BY M.S.D. (See detail below)
DUNDEE
RD.
STORM SEWER BY STATE HIGHWAY AGENCY

LOCATION PLAN


Buffalo
Creek
BRIDGE
N
8th green
bunker
bunker
NEW DITCH
BRIDGE
Slope
9th tee
RESERVOIR BY M.S.D.
2nd tee
BRIDGE
Slope
1st green
DITCH
NEW
BRIDGE
bunker
6th green by others
7th tee by others

CONSTRUCTION PLAN

EXHIBIT 3

METROPOLITAN SANITARY DISTRICT
OF GREATER CHICAGO
FLOOD CONTROL SECTION

G.H.G. NOV. 1972

BUFFALO CREEK RETENTION RESERVOIR, CONTRACT NO. 67-803-2F

Urbanization of the Buffalo Creek Watershed has increased storm runoff and flooding in areas adjacent to Buffalo Creek and the Wheeling Drainage Ditch in the Village of Buffalo Grove and Wheeling. To reduce this flooding, the proposed Buffalo Creek Retention Reservoir will impound approximately 700 acre-feet of storm water. This valley reservoir will be an earthfill dam located just west of Arlington Heights Road and south of Checker Road in Lake County. A culvert control structure will pass low flows and limit the maximum discharge from the reservoir to approximately 250 cfs. An emergency spillway will be provided to pass storm flows from storm events that exceed the 100-year storm event storage capacity and to protect the dam structure.

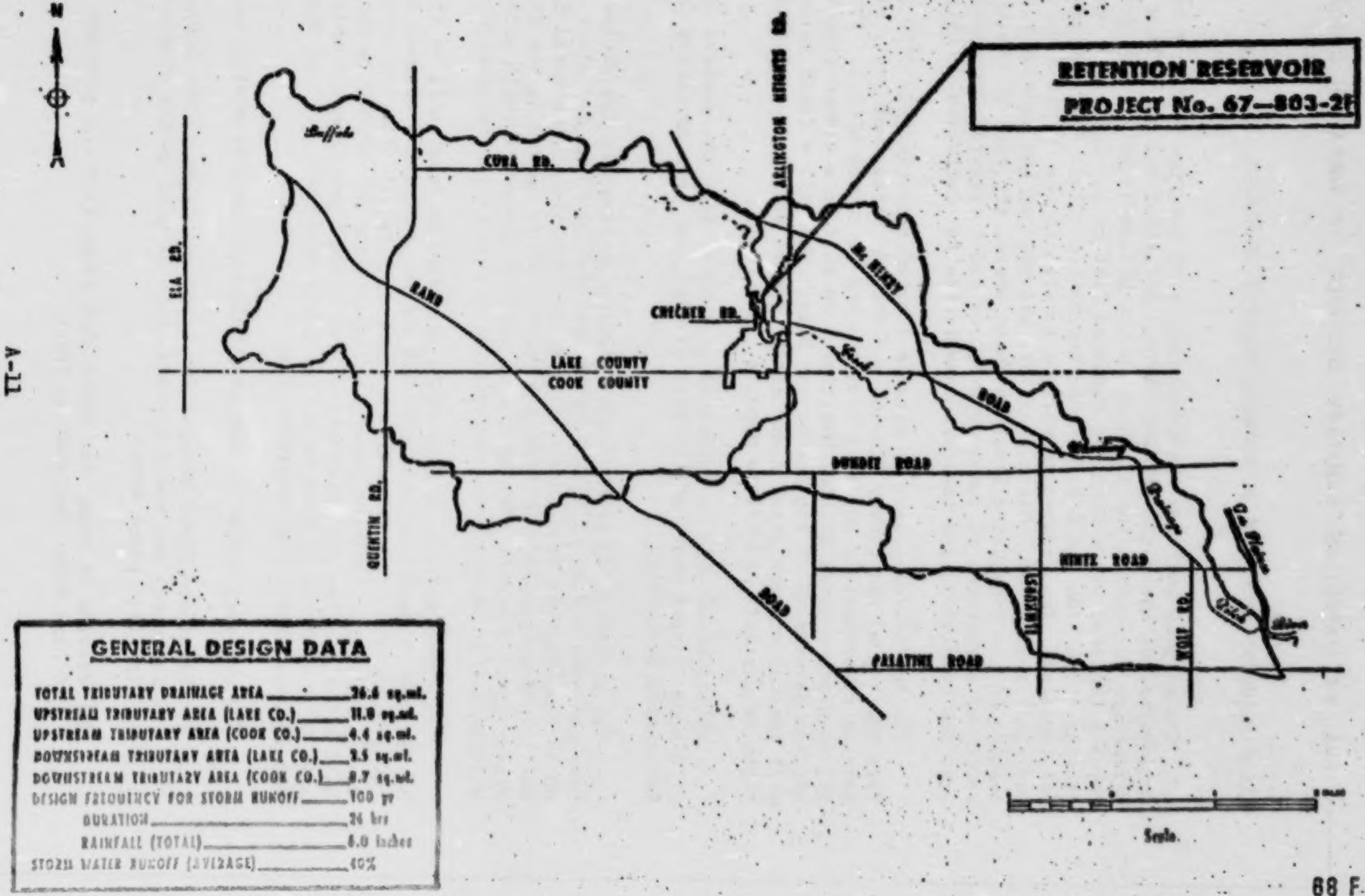
Additional construction work includes a levee or other flood protection method for the private buildings adjacent to the reservoir site north of Checker Road. Checker Road will be raised above the high water elevation as will the new bridge over Buffalo Creek. The reservoir site is approximately 160 acres located west of Arlington Heights Road in Section 31 of Vernon Township, Lake County. The site also included some area in Wheeling Township, Cook County. Total cost to the District is estimated at $2,100,000.

Project implementation will be guided by a Cooperative Agreement between the Lake County Forest Preserve District, Village of Buffalo Grove, and the Metropolitan Sanitary District.

The reservoir site will be a multiple-use facility for open space recreation uses, in addition to the primary function for flood control.

The Sanitary District has authority to undertake this work and commit funds without a general election. Plans and specifications will be available for bid advertisement in March, 1975. The construction contract will be let within 90 days after bid advertisement. Work will be completed by December, 1975.

PROPOSED RETENTION RESERVOIR SITE on BUFFALO CREEK


N
Buffalo
CUBA RD.
ELA RD.
RAND
ARLINGTON HEIGHTS RD.
CHECKER RD.
LAKE COUNTY
COOK COUNTY
Mc HENRY
ROAD
Creek
DUNDEE ROAD
QUENTIN RD.
ROAD
HINTZ ROAD
WOLF RD.
PALATINE ROAD
Drainage
Ditch
Des Plaines
River
Scale.

RETENTION RESERVOIR
PROJECT No. 67—803-2F

GENERAL DESIGN DATA

TOTAL TRIBUTARY DRAINAGE AREA __________ 26.6 sq.mi.
UPSTREAM TRIBUTARY AREA (LAKE CO.) ______ 11.0 sq.mi.
UPSTREAM TRIBUTARY AREA (COOK CO.) ______ 4.4 sq.mi.
DOWNSTREAM TRIBUTARY AREA (LAKE CO.) ____ 3.5 sq.mi.
DOWNSTREAM TRIBUTARY AREA (COOK CO.) ____ 8.7 sq.mi.
DESIGN FREQUENCY FOR STORM RUNOFF ______ 100 yr
DURATION ______________________ 24 hrs
RAINFALL (TOTAL) ________________ 6.0 inches
STORM WATER RUNOFF (AVERAGE) __________ 40%

WILLOW-HIGGINS RETENTION RESERVOIR, PROJECT 68-836-2F

The project includes the construction of two storm water retention reservoirs, Willow-Higgins Creek Channel Modifications and Willow Creek relocation to control the flooding in the Willow-Higgins Creek Watershed for the 100 year storm event as shown on Exhibit 1. This provides for storing flows from the O'Hare Water Reclamation Plant that exceeds channel capacity. The reservoirs will be located in the O'Hare Airport runway clear zone areas. Clear zones are provided at the ends of runways because of the high noise level in these areas, the need to control elevation of structures in runway approaches and to provide for aircraft over run conditions and thus are unavailable for individual public use.

The Ravenswood Reservoir site is located approximately 2750 feet from the end of the runway 32R-14L and the Lee Street Reservoir site is located approximately 900 feet from the end of runway 4L-22R. The Willow-Higgins Creek Channel Modifications will be a closed concrete section downstream of the Lee Street Site. The Willow Creek Relocation will consist of both grass lined earth channel and closed concrete sections as physical conditions permit.

Willow Creek will be relocated generally along the western limits of O'Hare Airport south of Old Higgins Road, and then northerly to the Ravenswood Reservoir.

The project will relieve the flooding problems in the Willow Higgins Watershed downstream of O'Hare Water Reclamation Plant for storm events up to the 100 year frequency. Relocation of Willow Creek would facilitate the future development of O'Hare Airport. Also, conveying the flow of Willow Creek drainage area to the Ravenswood Reservoir, will effectively utilize the greater storage capacity available at the Ravenswood site.

The flows added by O'Hare Water Reclamation Plant will be stored at Ravenswood Reservoir when the flow in the downstream channel exceeds the design capacity. These added flows will result from the treatment of flows from an ultimate population equivalent of 439,000 in the service area and also from the treatment of the storm flows from a combined sewer area of 8000 acres located in Weller Creek Watershed, part of Upper Des Plaines Tunnel and Reservoir Plan.

The proposed project would have following long term effects:

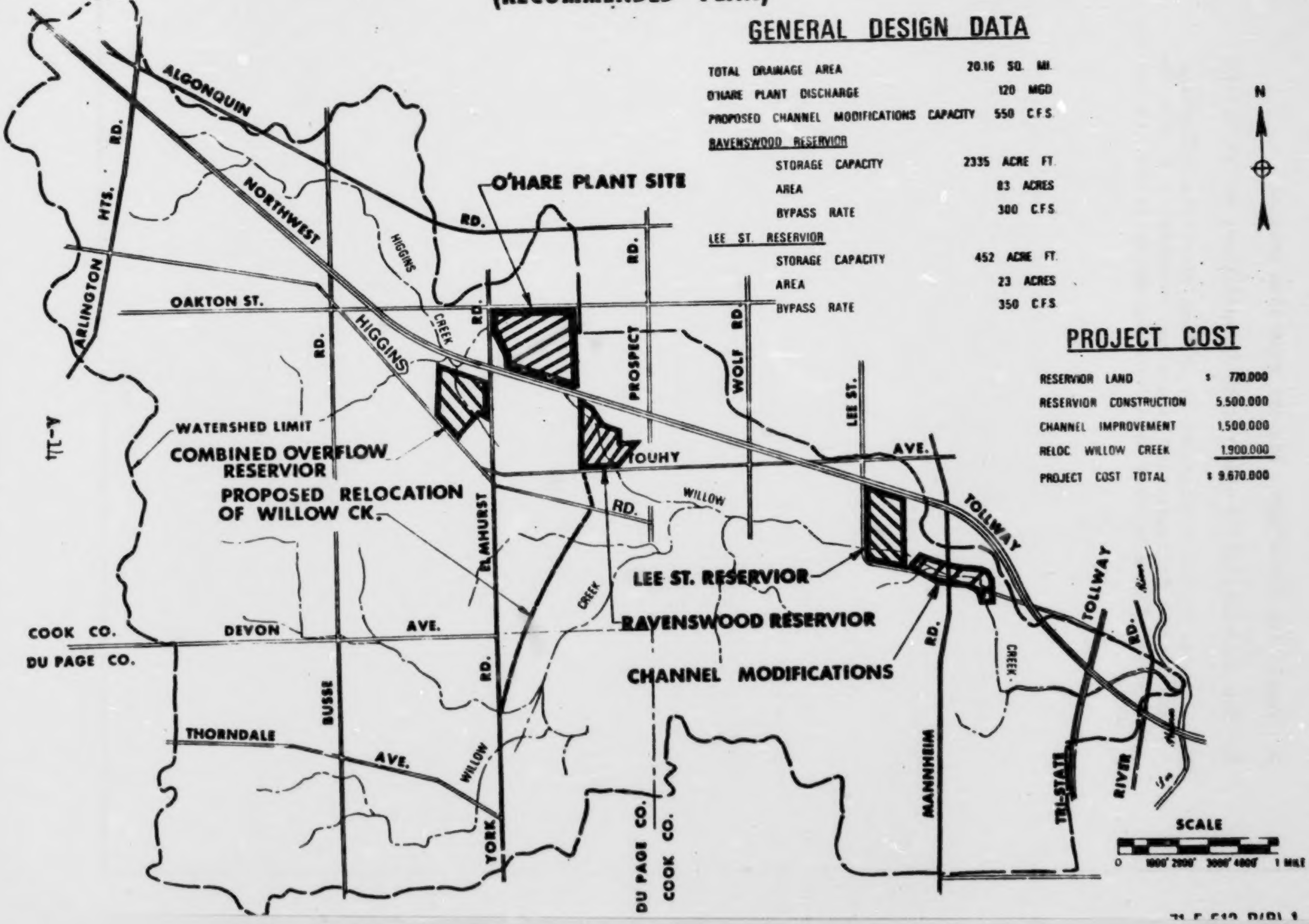
1. Eliminate flood damages for storm events up to the 100-year frequency and would provide peace of mind to the citizens in flood prone areas.
2. Provide storage for additional flows from the proposed O'Hare Water Reclamation Plant.

3. Facilitate the O'Hare Airport expansion program.

4. Use land located in clear zones for additional public benefit.

5. Increase property valuation by control of overbank flooding and thereby increase real estate tax revenues, even with the removal of some private land from the tax rolls for the project.

WILLOW - HIGGINS CREEK WATERSHED
(RECOMMENDED PLAN)



GENERAL DESIGN DATA

TOTAL DRAINAGE AREA	20.16 SQ. MI.
O'HARE PLANT DISCHARGE	120 MGD
PROPOSED CHANNEL MODIFICATIONS CAPACITY	550 C.F.S.
RAVENSWOOD RESERVIOR	
STORAGE CAPACITY	2335 ACRE FT.
AREA	83 ACRES
BYPASS RATE	300 C.F.S.
LEE ST. RESERVIOR	
STORAGE CAPACITY	452 ACRE FT.
AREA	23 ACRES
BYPASS RATE	350 C.F.S.

PROJECT COST

RESERVIOR LAND	$ 770,000
RESERVIOR CONSTRUCTION	5,500,000
CHANNEL IMPROVEMENT	1,500,000
RELOC WILLOW CREEK	1,900,000
PROJECT COST TOTAL	$ 9,670,000

N
O'HARE PLANT SITE
COMBINED OVERFLOW RESERVIOR
PROPOSED RELOCATION OF WILLOW CK.
WATERSHED LIMIT
LEE ST. RESERVIOR
RAVENSWOOD RESERVIOR
CHANNEL MODIFICATIONS
ALGONQUIN RD.
NORTHWEST TOLLWAY
ARLINGTON HTS. RD.
OAKTON ST.
HIGGINS RD.
HIGGINS CREEK
BUSSE RD.
ELMHURST RD.
PROSPECT RD.
WOLF RD.
LEE ST.
TOUHY AVE.
WILLOW CREEK
DEVON AVE.
THORNDALE AVE.
YORK RD.
MANNHEIM RD.
TRI-STATE TOLLWAY
RIVER RD.
COOK CO.
DU PAGE CO.
SCALE
0 1000' 2000' 3000' 4000' 1 MILE

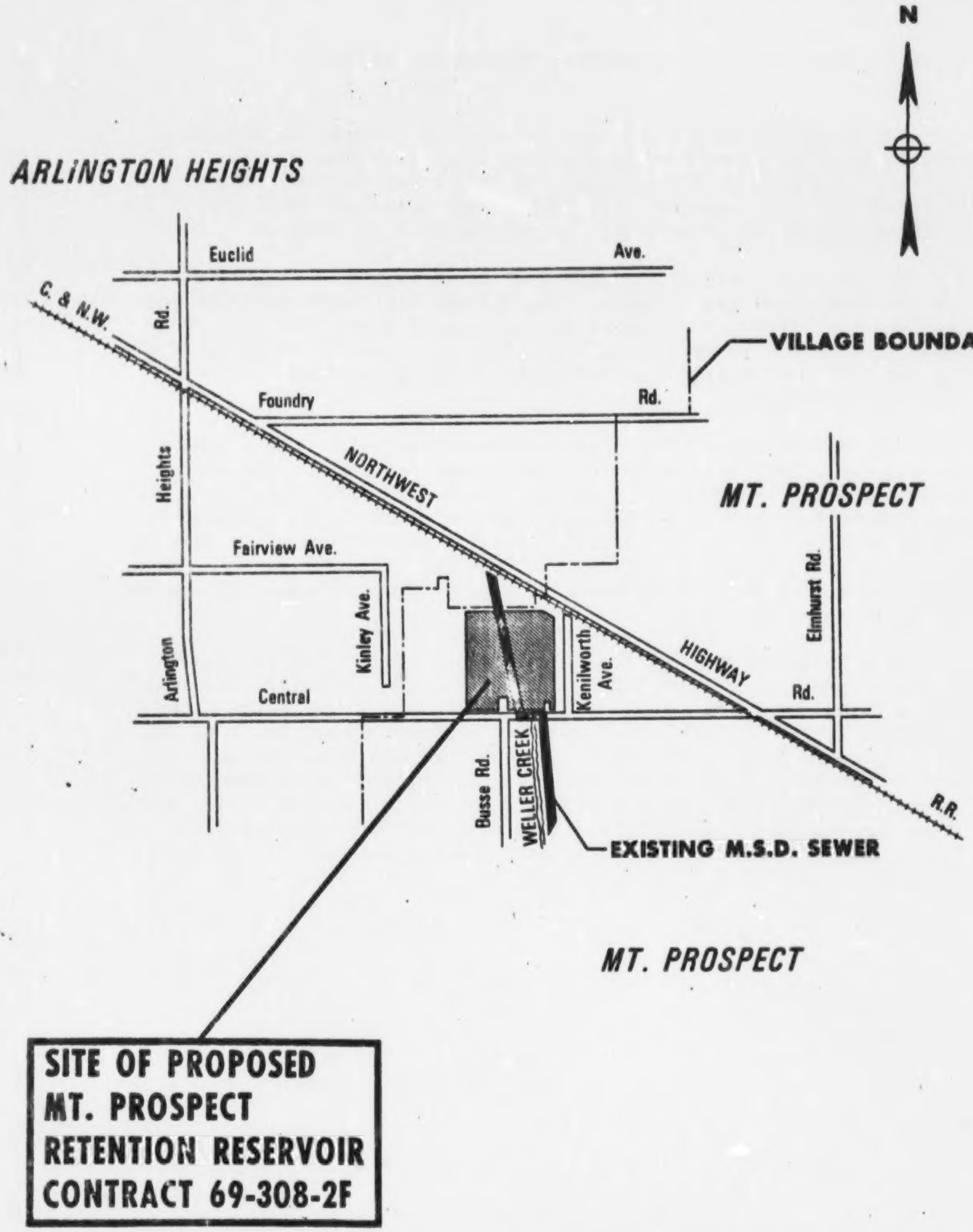
MOUNT PROSPECT RETENTION RESERVOIR, PROJECT NO. 69-308-2F

The reservoir will be an interim facility designed to provide a certain level of protection to the area until such time as the Tunnel and Reservoir Plan is implemented. At that time, the reservoir will be enlarged from 130 acre-feet (interim) to 850 acre-feet (ultimate). The basin will function by gravity. No pumping will be required.

The interim plan involved 130 acre-feet of storage providing relief to the upstream storm sewer system. The Village will be responsible for the measures necessary to convey separate storm flows into the reservoir. Conversion to the ultimate facility will involve enlargement of the reservoir and conveyance facilities to bring combined overflows into the reservoir.

The interim facility will store storm flows only. The ultimate facility will include measures to handle combined flows. The DeLeuw Cather report, "Preliminary Plans for O'Hare Collection Facility", concerns the O'Hare Tunnel and Reservoir system of which the ultimate facility will be a part. The interim facility is not covered in this report. Detailed design and analysis of the interim proposal will commence subsequent to the completion of negotiations with the Village and the purchase of the site.

Drop Shaft No. 1 under the Tunnel and Reservoir Plan for the (O'Hare) Upper Des Plaines Basin will be situated at Central Road and Weller Creek. The 850 acre-foot Mount Prospect combined waste water detention basin will function to limit the flow to Shaft No. 1 to 800 cfs. Based on a fully developed upstream drainage area, and an unrestricted upstream local sewer system (exceeding 100-year design storm frequency), this flow was exceeded 24 times in the 21 year record period, there were 21 times the maximum detention volume did not exceed 100 acre-feet. Twelve times the volume detained did not exceed fifty acre-feet. The maximum time of detention in the study period was 20 hours. This was for a recurrence of the July 1957 storm. In general, the detention period would be a small fraction of the 20 hour maximum even under full development conditions.


N
ARLINGTON HEIGHTS
Euclid Ave.
C. & N.W.
Arlington Heights Rd.
VILLAGE BOUNDARY
Foundry Rd.
NORTHWEST HIGHWAY
MT. PROSPECT
Fairview Ave.
Kinley Ave.
Kenilworth Ave.
Elmhurst Rd.
Central Rd.
Busse Rd.
WELLER CREEK
R.R.
EXISTING M.S.D. SEWER
MT. PROSPECT
SITE OF PROPOSED
MT. PROSPECT
RETENTION RESERVOIR
CONTRACT 69-308-2F

THE METROPOLITAN SANITARY DISTRICT
OF GREATER CHICAGO

ENGINEERING DEPARTMENT

F.J.K. **AUG., 197**

APPENDIX B

MSDGC TARP PROGRAM

Combined Sewer Overflow Elimination

The selected plan for eliminating untreated combined sewer overflows or plant bypasses was chosen from various alternatives and was described in the August 1972 "Summary of Technical Reports," presented by the Flood Control Coordinating Committee. Since 1972 refinements to sub-systems of the plan have been made as additional studies and sub-surface exploration work have been performed.

This chapter first describes the August 1972 Recommended Plan and then describes the five revisions that have been made. These revisions do not change the concept of the plan but only present additional development of the project to reflect sub-system optimization.

August 1972 FCC Recommended Plan

Description and Maps

After extensive review of the alternatives, the Flood Control Coordinating Committee unanimously agreed that the Alternatives "G", "H", "J" and "S" Mod 3, are less costly and would be more environmentally acceptable to the community than any of the other plans presented. Detailed studies and layouts along the lines of these plans were then continued to develop the recommended plan.

The system recommended herein, a composite of several of the above Alternatives, is outstanding in its relative storage economy and simplicity. It will capture the total runoff from all of the record meteorological sequences of history, if they were to recur on future ultimate developed drainage basins, except for the peak few hours of three of the most severe storm events. The system will convey these captured combined sewer flows through high velocity, out-of-sight underflow tunnels below the routes of the existing surface watercourses to large pit-type storage reservoirs. Figure M-IX-1 shows the general location of the conveyance tunnel system and storage reservoirs.

The primary storage reservoir is shown located in the area now occupied by the sludge lagoons of the Metropolitan Sanitary District in the McCook-Summit area. This reservoir will be in the form of a 300 to 330 feet deep rock quarry, with a maximum water depth of approximately 200 feet, in the heaviest storm event, and water surface dimensions averaging about 1,000 feet wide by 2 1/2 miles long. Total storage capacity of the reservoir with the water surface as its maximum level of -100 CCD, will be 57,000 acre-feet.

Figure M-X-2 shows the general layout of the reservoir, conduits and pumping facilities. The lower 100 feet of depth of the reservoir will be divided into three basins by transverse dikes, providing two small basins, each with a volume of 5,000 acre-feet for the more frequent small runoff periods. The larger runoff volumes will flood the remaining basin and the water surface will rise in elevation over the entire reservoir.

The dewatering pumping station shown on Figure M-X-2 will discharge from the storage reservoir to the West-Southwest Treatment Plant at an average rate of about 700 cfs. The station's total capacity will be 2400 cfs in order to dewater the conveyance tunnels and Stearns Quarry into the reservoir within two or three days following a storm.

Computer studies indicate that the storage utilized in Basins 1 and 2 will exceed their combined volume (10,000 acre-feet) at an average frequency of six or seven times per year and that these two basins alone will entrap more than 70% of the annual combined sewer spillage containing over 95% of the annual Suspended Solids.

The use of a deep pit storage basin of such magnitude and depth requires that aeration be provided to insure positive odor control by floating equipment. This is necessary because the range of liquid level varies over 200 feet. It is proposed to use submerged turbine aerators provided with a downflow draft tube with air injection below the propeller.

The submerged turbine aerators will be provided with a bar screen to prevent large ice chunks from being drawn into the draft tube and damaging the blades. The aerators will be provided with legs to protect the draft tube and will need a minimum of 20 feet of water to operate. When floating at greater depths, it is considered that active aeration will be limited to the upper 50 feet of the water in storage.

Aerators, in the heaviest rainfall year will be in near continuous operation in or above Basins 1 and 2. A lesser amount of aeration on an intermittent schedule will be required in Basin No. 3.

An aerated reservoir of lesser depth and a volume of 1,800 acre-feet, will be provided near the proposed O'Hare Water Reclamation Plant, to serve the combined sewered area of the suburban communities to the northwest.

Another reservoir will utilize the existing Stearns rock quarry in the vicinity of 28th and Halsted Streets. This reservoir will provide approximately 4,000 acre-feet of storage space and will be used only during record storm events to flatten out the peak discharge through the conveyance tunnels.

Conveyance Tunnels

There are approximately 120 miles of conveyance tunnels intercepting 640 sewer overflow points in the 375 square mile area served by combined sewers. Most of the conveyance tunnels will be constructed in the Silurian Dolomite rock formation 150 to 300 feet below the surface of the waterways. In some areas, the smaller tunnels will be constructed in the clay overburden. See Figure M-X-3, 4 for profiles of the tunnels.

The tunnels will in general be drilled by mining machine (moles), except for the largest sizes which will probably be constructed by the conventional drill and blast method.

Three main conveyance tunnel systems fork out from the primary reservoir facility located in the McCook-Cummit area. See Figure M-X-1. Figure MX-1. The Des Plaines Tunnel System extends north along the Des Plaines River to the Village of Des Plaines, thence northwest terminating at the Village of Palatine. The Mainstream Tunnel System extends under the Sanitary and Ship Canal, the North and South Branches of the Chicago River and the North Shore Channel to the Wilmette controlling works. The Calumet Tunnel System extends south and southeasterly along public right-of-way to the Sag Channel, thence eastward under the Little Calumet, Grand Calumet and Calumet Rivers to near the State Line. The storage space in the conveyance tunnel system is 9,100 acre-feet.

Drop Shafts

The spillages will be delivered to the tunnels by hundreds of vertical drop shafts, capturing the present spillage from the existing riverbank sewer outlets of over five thousand miles of near-surface sewer systems. A typical drop shaft is shown in Figure M-X-5.

The drop shafts will have a split vertical shaft, one side for water and the other side for air. The center dividing wall will have slots to insufflate air in the falling water. This reduces the impact when the air-water mixture hits bottom. An air separation chamber is provided to reduce the amount of air entering the tunnel. At the top, a vent chamber will allow air to escape during filling and to be drawn in during dewatering.

Groundwater Protection and Recharge

The major project elements are sited in rock units of the Silurian System of the geologic strata underlying the Chicagoland area. These limestone and dolomite rock units, together with the hydraulically interconnected overlying glacial drift, comprise the so-called shallow aquifer of the region which is recharged by local rainfall.

Additional data on protection of groundwater and limitation of infiltration into tunnels and storage areas is available in Technical Report No. 4, Geology and Water Supply. This upper aquifer system is used as a water supply for individuals and certain municipalities. However, the water supply for the vast majority of the area is through piped systems using Lake Michigan water.

The preservation of groundwater quality and quantity is achieved by positioning the project elements in the best available rock units, taking advantage of the natural low permeabilities of the rock and augmenting this low permeability by sealing the water bearing bedding planes and joints, thus providing for elimination of the direct connections between the aquifer and the project element.

Additionally, the naturally high piezometric level within the aquifer will provide a positive inward presssure providing additional assurance against exfiltration of flows. In those areas were excessive groundwater withdrawals occur, adversely lowering the groundwater table, the added protection could be provided by artificial recharge to restore high levels around the project element. The identification of this recharge need, however, can only be made after sub-surface exploration, testing and detailed positioning of the project elements.

Benefits

A brief listing of anticipated benefits to be derived from completion of the system of flood and pollution control proposed herein, includes the following:

1. Protection of the valuable water resources of Lake Michigan from flood release of river water as now required through the existing Chicago River, the North Shore Channel and the Calumet River into Lake Michigan.

2. Achieving and maintaining acceptable water quality (in accordance with National Goals and Regulations of the Illinois Pollution Control Board and the Metropolitan Sanitary District) in the open waterways known as the Chicago River and its branches, the Sanitary and Ship Canal, the North Shore Channel, the Calumet-Sag Channel and those portion of the Calumet River, Des Plaines River, Salt Creek and other open waterways, under the jurisdiction and control of the Metropolitan Sanitary District of Greater Chicago.

3. Reduction of surface and basement flooding by underground backwaters or overbank flooding.

4. Improvement of recreational values of all surface waterways.
5. Increase in property values due to general improvement of environment.

Additional Plan Developments

The plan described in previous sections was produced in 1972. The intervening two years have provided the opportunity to incorporate new analysis and information, and improve the Plan accordingly. These up-dates can be grouped under five headings, with the revised Recommended Plan shown on the attached map (Figure M-X-6).

a. Independent Calumet System: The most significant revisions are the separation of the Calumet Area from the Central System and having an independently operating system with dewatering to the Calumet Plant.

The decision to separate the Calumet Area was based on detailed study(2) of operational flexibility and cost. This study originated with the recognition that several potential reservoir sites exist in the Calumet Area, and the cost of the 55,000-foot connection tunnel ($100 million) would be saved by independently operating systems.

The study considered three alternative concepts, each with several variations:

A. Maximum Size Intertie Tunnel Plan: In this plan, no storage would be provided in the Calumet area. All flow would be directed to the McCook-Summit area terminal reservoir. Economies would be realized by concentrating terminal reservoir facilities. These savings would be compared to the extra costs associated with conveyance facilities required to concentrate the storage.

This scheme is similar to the layout shown in Figure M-X-1 (the Recommended Plan from the Summary of Technical Reports) for the project area remaining after exclusion of the O'Hare sub-project area. However, these studies included drainage flow from the communities of Lansing and part of Markham which were not a part of the prior studies made in support of the Summary of Technical Reports. This additional drainage flow is included as well in all other alternatives evaluated in this study.

An Intermediate Size Intertie Tunnel Plan. Storage would be provided in the Calumet area but it would be an amount which would be insufficient to accommodate all of the runoff in the Calumet area during a large storm. In these instances, the Calumet area reservoirs would fill and, subsequently, flow would be diverted through the intertie tunnel to the McCook-Summit area reservoir.

No Intertie Tunnel Plan. In this scheme, storage volume provided in the Calumet area would be sufficient to accept the excess combined sewer flow in that area. The Mainstream and Des Plaines Tunnel Systems would drain to the McCook-Summit area terminal reservoir.

Several variations within each of the above basic concept plans are possible and were examined in this study so that the least-cost representation of each of the above concepts could be identified. This led to development of twelve separate project layouts for comparative evaluation, which included different reservoir locations and tunnel systems.

Initial Evaluation of Project Layouts: The evaluation and cost estimating methods employed in the initial phase of this study are identical to those used in the studies which are reported in the Summary of Technical Reports. The same basic unit costs and cost curves were used as were the computer programs previously developed. These were accepted and used to conduct simulation studies which yielded results concerning performance of the twelve project layouts. A "trial and error" procedure was employed in the development of these layouts wherein tunnel diameters and reservoir sizes were first assumed; then, for selected storm events, the system performance was simulated by electronic digital computer cooperation; and system performance deficiencies were noted upon completion of the computer run. Adjustments were then made in tunnel diameters and reservoir dimensions as indicated by the simulation analysis results. The procedure was repeated until all of the twelve project layouts satisfied the performance requirements. These performance requirements were to limit the overflow quantities during repeat of the largest storms to prevent backflow to the Lake and to treat the captured water at the existing treatment plants at a rate such that the total flow to the plant combined with dry weather flow did not exceed 1.5 times average dry-weather flow. The estimates of costs of construction of the sanitary systems were compiled using the cost parameter data developed for the prior studies.

The general approach employed in the initital evaluation phase of this study is presented here. The prior studies which are described in the Summary of Technical Reports showed that, of the 21 year continuous record of precipitation, a tunnel-reservoir system which functioned adequately in simulation analysis during the events of July 12-13, 1957 and October 3-12, 1954 would also function satisfactorily throughout the remainder of the period of record. Further, the tunnel sizes required in any given layout were dictated principally by conditions which prevailed during the 1957 storm; a storm which yielded the maximum instantaneous peak runoff flow. Also, the prior studies showed that the total reservoir storage volumes required were controlled by the conditions which obtained during the 1954 storm.

Moreover, an approximate correlation existed between the reservoir requirements established by simulation of the 1957 storm and those established by simulation of the 1954 storm.

For these initial evaluation studies, only the July 12-13, 1957 precipitation event was used in simulation analysis step of the work. This was made necessary because of the large number of computer runs required and the especially lengthy run-time of the 1954 event simulation. The July, 1957 analyses yielded the required tunnel diameters of the several schemes. The construction costs of these tunnel networks were computed. The July, 1957 analyses also indicated reservoir volume requirements for satisfactory system performance for this event. These values were extrapolated to approximate total reservoir volume requirements which would be needed for satisfactory system performance during the October, 1954 storm. Reservoir construction cost estimates were then developed.

Cost comparison of the twelve alternatives was made on the basis of the sum of the tunnel and reservoir costs. These were regarded as the controlling project costs since these two project compontents comprise approximately ninety percent of the total construction cost. Additionally, much of the remaining 10 percent of construction costs consist of modification of surface collection facilities and drop shafts, both elements being a common and near-constant cost factor for all proposed systems.

"Least Cost" Alternatives - Detailed Evaluations: The maximum size intertie tunnel plan (Scheme 1A), the intermediate size intertie tunnel plan (Scheme 2E), and the no intertie tunnel plan (Scheme 3A), having been identified as the most economicaly systems for each of the three concepts, were examined in greater detail than the remainder of the alternatives. Each of these schemes include the use of existing quarries as reservoirs. These quarries, already having depths in excess of 200 feet and large volumes available, had distinct advantages over other sites with no significant existing storage volume such as in the sludge lagoon sites. Preliminary reservoir layouts were made for these plans and more detailed construction cost estimates were prepared as shown in Table M-X-1.

The totals show the cost advantage of 3A, separation. Additional advantage is found in the freedom of construction phasing.

TABLE M-X-1 LEAST COST SCHEMES ESTIMATE OF CONSTRUCTION COSTS; MILLIONS OF DOLLARS (Based on a Limitation of Stockpile Height of 200 Feet in the McCook-Summit Area)

Sum of Tunnels and Reservoirs (1972 Costs, Unescalated)

Item	Scheme 1A	Scheme 2E	Scheme 3A
1. McCook-Summit Reservoir[2]	496	351	286
2. Thornton Reservoir[2]	-	56	74
3. Mainstream On-Line Reservoir	15	15	15
4. Tunnels[1]	691	568	552
5. Pumping Stations			
a. McCook-Summit	71	65	64
b. Stearns Quarry	8	8	
c. Thornton-Calumet	-	30	30
TOTAL, without contingencies	1,281	1,093	1,029

---

[1] Estimates of tunnel cost require a determination of whether or not they are concrete-lined. The final decision concerning concrete lining must be reserved for the design phase of the project and completion of subsurface investigations. This decision cannot alter the conclusions of this optimization study because all project layouts will be similarly affected.

[2] Includes credit for future sale of rock and other future land values.

As a result of these studies, the interconnecting tunnel has been eliminating and planning and subsurface explorations have been concentrated on development of the plan with an independently operating Calumet System.

b. Palatine Tunnel Elimination

An additional revision is the elimination of a tunnel leg into the Village of Palatine. A report titled "Preliminary Engineering Study of Palatine, Illinois for Intercepting and Holding Combined-Sewage Overflows" was completed in September, 1973. Eighteen alternate solutions were studied. The lowest cost alternate for a tunnel and reservoir concept system for Palatine area to connect to the O'Hare System, as originally proposed was $22,700,000. Of the alternates discharging to Salt Creek Water Reclamation Plant, the lowest cost was $17,300,000; however, the recommended tunnel and reservoir concept system was estimated at $18,900,000. It was further established that construction of a separate new five-year storm sewer system for the combined-sewer area would cost $11,100,000 and the construction of a new sanitary sewer system would cost an estimated $12,700,000. Either a new storm sewer system or new sanitary sewer system would eliminate combined-sewer overflows in this drainage basin.

At the regular Board Meeting of April 22, 1971, the Board of Trustees of the District approved the U.S. Soil Conservation Service Upper Salt Creek Watershed Work Plan. This plan, of which the District is a local sponsor, is a comprehensive program which will prevent overflow of Salt Creek in the Palatine area. The District has already committed $4,861,000 for seven projects under the Work Plan. In view of this program, the flood control benefits of the District's Tunnel and Reservoir Plan for the Palatine area will not be required.

The estimated cost of the tunnel and reservoir plan exceeds the estimated cost of separating sewers within that portion of the Village of Palatine which has combined-sewers; and therefore, the tunnel and Reservoir concept is not the cost-effective method for preventing discharge of combined-sewage to the waterways.

Therefore, the Palatine tunnel leg in the Northwest Area of the District has been eliminated and at meetings with the Village of Palatine the Village Officials have been so informed.

c. Mainstream Dual Tunnel System

A third revision or updating includes dual tunnels for the Mainstream System from Summit to Lawrence Avenue. The August 1972 Plan included a 42-foot diameter or equivalent along this reach. In order to maintain a uniform slope, this tunnel would have to be constructed through the Maquoketa shale. This shale formed from clay sized particles is a softer rock than the dolomitic limestone, and presents different stability considerations for both long-term use and during construction. Thus, the construction in this shale will be more costly than in limestone.

During 1974, additional rock borings have been made to further identify the location of this shale formation and additional analysis have been performed. As a result, it has been determined that the most cost-effective plan is to construct a smaller tunnel first at the required slope and at a latter date construct a second tunnel which would be totally in the limestone formations. Each of the dual tunnels would provide one-half the required conveyance capacity.

TABLE M-X-2 TUNNELS MAINSTREAM SYSTEM (McCook to Confluence)

	SINGLE TUNNEL			DUAL TUNNELS			
				Stage I		Stage II	
LINE	LENGTH	DIA.	COST $ x 1000	Dia.	COST $ x 1000	DIA.	COST $ x 1000
2	6,930	45	$ 17,000	33	$ 10,570	35	$ 11,500
3	7,095	42	15,600	33	10,820	35	7,810
4	13,575	42	29,800	33	20,700	35	14,930
5	8,00	42	17,600	33	12,200	35	8,800
6	8,600	42	18,900	33	13,120	35	9,460
7	7,332	42	16,100	30	9,750		
8	8,368	42	18,400	30	11,130		
9	10,992	42	24,100	30	14,620		
10	11,718	42	25,700	30	15,590		
11	8,285	42	18,200	30	11,020		
12	4,095	42	10,800	30	6,520		
13	5,451	42	11,900	30	7,250		
14	4,104	42	9,010	30	3,650		
15	3,823	42	8,390	30	3,400		
16	2,865	42	6,290	30	2,550	35	3,150
48	24,400					35	26,840
49	11,300					35	12,430
50	14,580					35	16,038
SUBTOTAL			$247,790		$152,890		$110,958
TOTAL			$247,790			$263,848	

Cost shown exclude shafts, connecting structure and contingences

The Table M-X-2 compares the construction costs of the single tunnel with the costs of the dual tunnel system. As can be seen the cost difference is $16 million or 6 per cent of the total. This difference is insignificant when considering the total costs of the program. Therefore, also considering the uncertainties of grant funding, the dual tunnel system is chosen because the first tunnel can be constructed at a lower initial cost and provide for the capture of in excess of 80 per cent of the pollutants now discharged to the waterways, and thus obtain an early return on the invested funds. The dual tunnel system also offers time to further optimize the size needed for the second tunnel to meet project objectives.

d. Mainstream On-Line Reservoir

Another revision has been elimination of Stearns Quarry as the location of the Mainstream On-Line Detention Reservoir. This reservoir has been included in the Plan in order to reduce the size and cost of the Mainstream Tunnel System. Without such a reservoir, the lengthy Mainstream Tunnel would have to increase in size from a 42-foot diameter equivalent tunnel to a 55-foot diameter equivalent tunnel(2).

The Stearns site is now being filled in and will eventually be used as a park. The previous studies had considered this site only in relation to evaluating different alternatives of solving the combined-sewer overflow problem, and not in terms of the specific details of the site. It has now been determined that the best and highest use of the site is as a park.

In its place, a Mainstream On-line Reservoir at an unidentified site is included. The location of this reservoir can be anywhere along the tunnel between the Stearns site and Wilmette Harbor. Since this reservoir will be used only during the large storms of record to reduce the peak flow rates to the tunnels, it will be one of the last facilities to be constructed. If a suitable site is not found for the reservoir, the alternative does exist to increase the size of the second tunnel of the Mainstream Dual Tunnel System.

e. Des Plaines Watershed

A fifth revision provides for the total capture of the combined-sewer overflows in the Des Plaines River Watershed. The August 1972 Plan included the equivalent of a Mod 3 level of capture for the sizing of the Des Plaines River Tunnel and the O'Hare Northwest System. However, as was stated in the report, total capture would be needed in order to meet the higher water quality standards of the General Use and the Public and Food Processing Water Supply Designated waterways. (See Figure M-X-7.) This was the case in the Little Calumet River and the North Branch of the Chicago River Upstream with its junction with the North Shore Channel. Tunnel sizing is provided so as not to spill into these waterways.

The higher water quality standards for the above waterways includes, among others, the requirement that the dissolved oxygen level shall not fall below five milligrams per liter at any time. The computer simulation of the overflows into the Chicago and Calumet River Systems (designated as secondary contact waters) demonstrates that depression of the oxygen levels below five milligrams per liter will occur. Since these latter waterways have a lower water quality designation and instream aeration is to be provided the Mod 3 level of protection is judged to be adequate. However, it is not judged to be adequate in the Des Plaines River Watershed. A computer model of the Des Plaines River has not been developed as for the above waterways. However, the same level of contaminants would be discharged during overflow and the results can be expected to be the same.

Therefore, the plan now includes reservoir capacity in the O'Hare Area to provide for total capture and increased sizing in the Des Plaines River tunnels to transport a higher rate of flow to the Mainstream-Summit Reservoir.

In the O'Hare Area, the August 1972 Report provides for an 1800 acre-foot reservoir including capacity for Palatine. Subsequent Analysis (3) demonstrates that 1280 acre-feet is required for the equivalent of Mod 3 level storage for the O'Hare sewered area and 2700 acre-feet for total capture. Provision for the latter quantity of storage is being included in the Plan. The sizing of the tunnels is not changed because of the decision to include total capture. The tunnel size has been chosen to transport dry-weather flows to the O'Hare Plant, and on the basis of transporting peak storm flows with an On-line reservoir providing for the detention of peak flow rates so as to control the tunnel surcharge. The cost of both the 2700 acre-foot O'Hare terminal storage reservoir and the On-Line reservoir is included in the Plan.

The Des Plaines River Tunnel has been increased in size to provide for total capture. This size increase is shown on Table M-X-3. The original size was picked such that spillage to the waterways occurred during a repeat of the July 1957 storm, (the storm of record for rate of flow) at approximately the same ratio to total flow as in the Chicago and Calumet River Systems. During the 1954 storm (the storm of record for total volume), there was no spillage to the Des Plaines River and the total flow was transported to the reservoir. Thus, no additional storage volume is needed to provide for total capture and only increased tunnel sizing is required.

TABLE M-X-3 TUNNELS- DES PLAINES RIVER SYSTEM

LINE	LENGTH (ft.)	TOTAL CAPTURE		MoD 3 LEVEL PROTECTION	
		DIA. (FT.)	COST ($ x 1000)	DIA. (FT.)	COST ($ x 1000)
18	8800	36	15,224	30	11,704
19	5040	15	2,974	15	2,974
20	11,280	10	3,948	15	6,655
21	9460	36	16,366	30	12,582
22	12,200	32	17,690	25	12,810
23	11.200	15	6,608	15	6,608
24	8160	32	11,832	25	8,568
25	14,390	32	20,866	25	15,110
26	5100	32	7,395	25	5,355
27	8600	24	8,600	25	9,030
28	7050	24	7,050	25	7,403
29	10,380	24	10,380	20	8,304
30	6470	24	6,470	20	5,176
TOTAL	118,130		135,403		112,279

Cost shown exclude shafts, connecting structures and contingencies

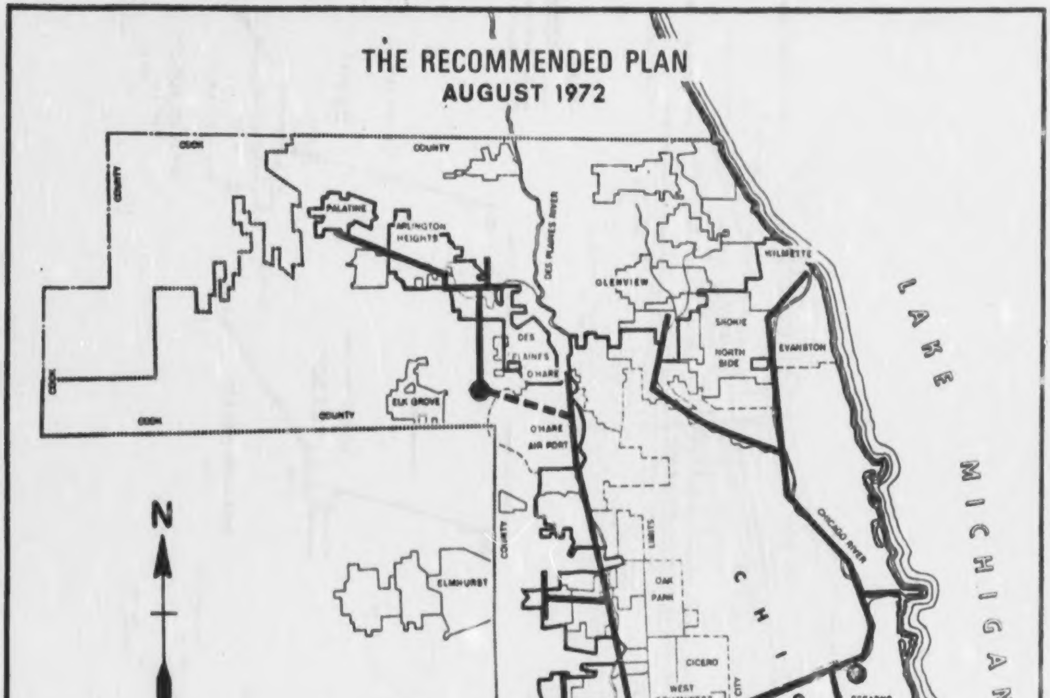
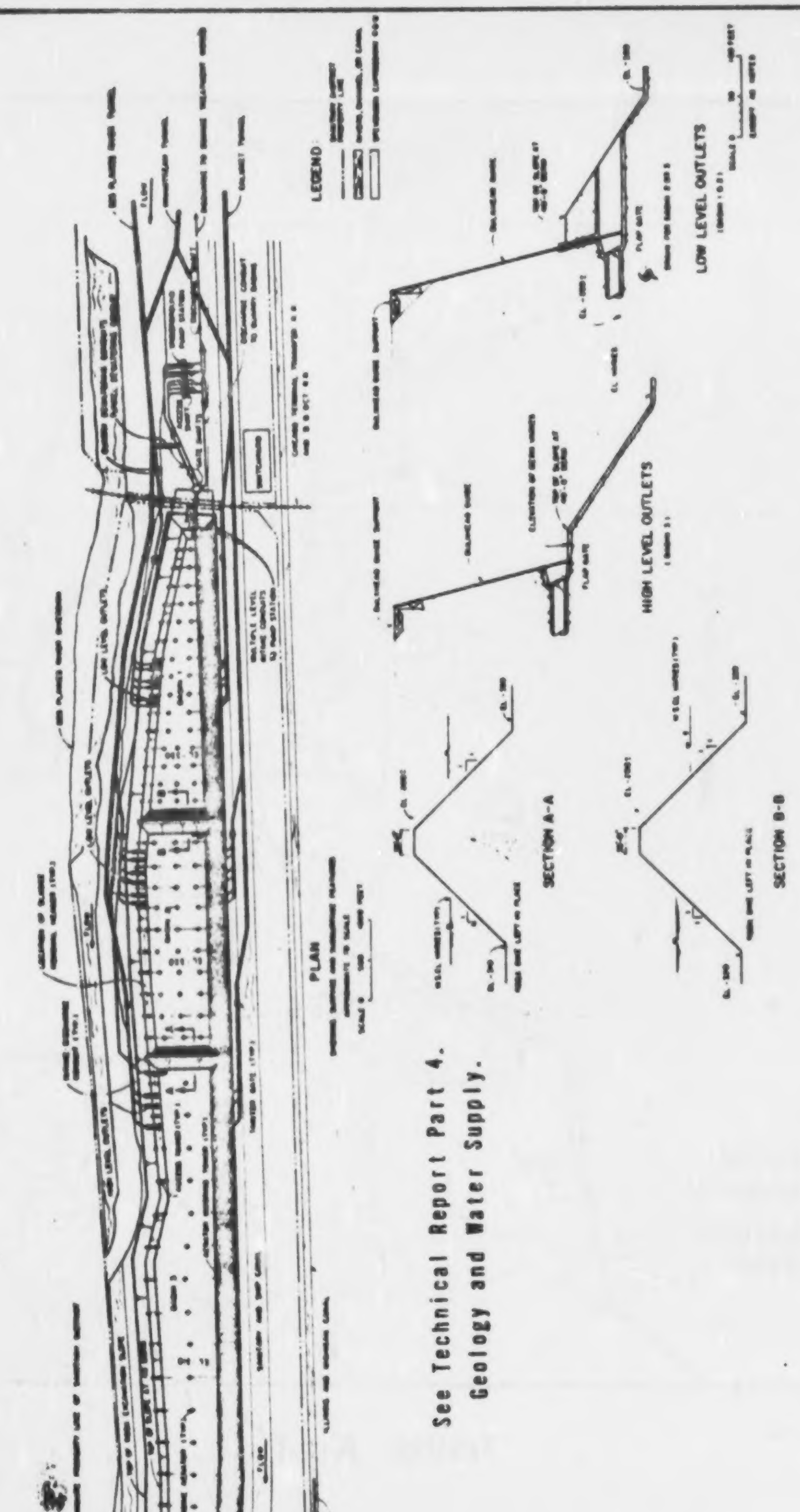

THE RECOMMENDED PLAN
AUGUST 1972
COOK
COUNTY
PALATINE
ARLINGTON HEIGHTS
DES PLAINES RIVER
GLENVIEW
WILMETTE
SKOKIE
NORTH SIDE
EVANSTON
DES PLAINES
O'HARE
ELK GROVE
O'HARE AIR PORT
LAKE MICHIGAN
CHICAGO RIVER
N
ELMHURST
OAK PARK
CICERO
WEST SOUTHWEST
CHICAGO
CITY LIMITS
STEARNS QUARRY
DOWNERS GROVE
SUMMIT
MC COOK
SAN. AND SHIP CANAL
OAK LAWN
CAL-SAG CHANNEL
DES PLAINES RIVER
CALUMET
CALUMET RIVER
LOCKPORT
HOMEWOOD
LANSING
JOLIET
STORAGE RESERVOIRS
TREATMENT WORKS

FIGURE M-X-1

FIGURE M-X-2

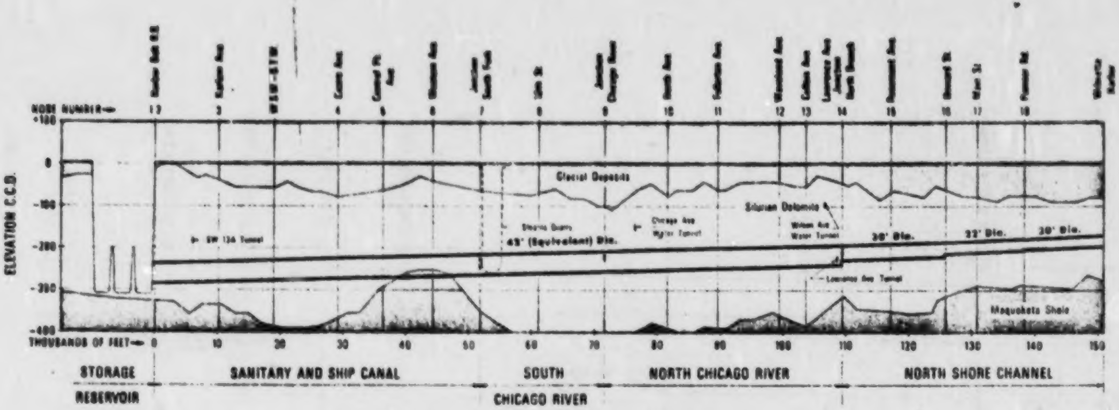

LEGEND
PLAN
SECTION A-A
SECTION B-B
HIGH LEVEL OUTLETS
LOW LEVEL OUTLETS
FLAP GATE

See Technical Report Part 4.
Geology and Water Supply.

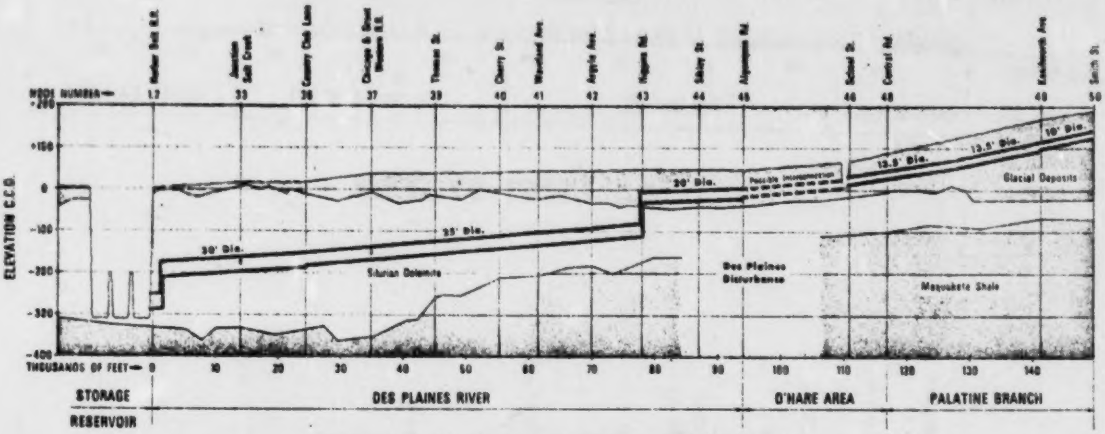
DEVELOPMENT OF A FLOOD AND POLLUTION
CONTROL PLAN FOR THE CHICAGOLAND AREA
PART 5 - ALTERNATIVE SYSTEMS

PRELIMINARY LAYOUT OF STICKNEY RESERVOIR

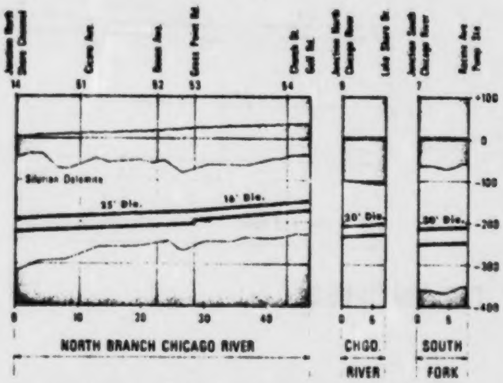
DECEMBER, 1972


NODE NUMBER
ELEVATION C.C.D.
Glacial Deposits
Silurian Dolomite
SW 13A Tunnel
42' (Equivalent) Dia.
Chicago Ave Water Tunnel
Wilson Ave Water Tunnel
30' Dia.
22' Dia.
20' Dia.
Lawrence Ave Tunnel
Maquoketa Shale
THOUSANDS OF FEET
STORAGE
RESERVOIR
SANITARY AND SHIP CANAL
SOUTH
CHICAGO RIVER
NORTH CHICAGO RIVER
NORTH SHORE CHANNEL

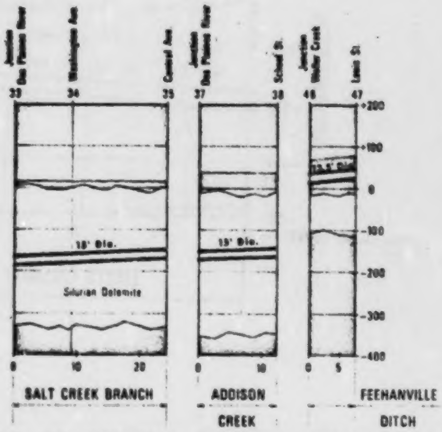
MAINSTREAM SYSTEM


NODE NUMBER
ELEVATION C.C.D.
30' Dia.
25' Dia.
20' Dia.
Possible Interconnection
13.5' Dia.
10' Dia.
Glacial Deposits
Silurian Dolomite
Des Plaines Disturbance
Maquoketa Shale
THOUSANDS OF FEET
STORAGE
RESERVOIR
DES PLAINES RIVER
O'HARE AREA
PALATINE BRANCH

DES PLAINES RIVER SYSTEM


Silurian Dolomite
25' Dia.
16' Dia.
20' Dia.
NORTH BRANCH CHICAGO RIVER
CHGO. RIVER
SOUTH FORK

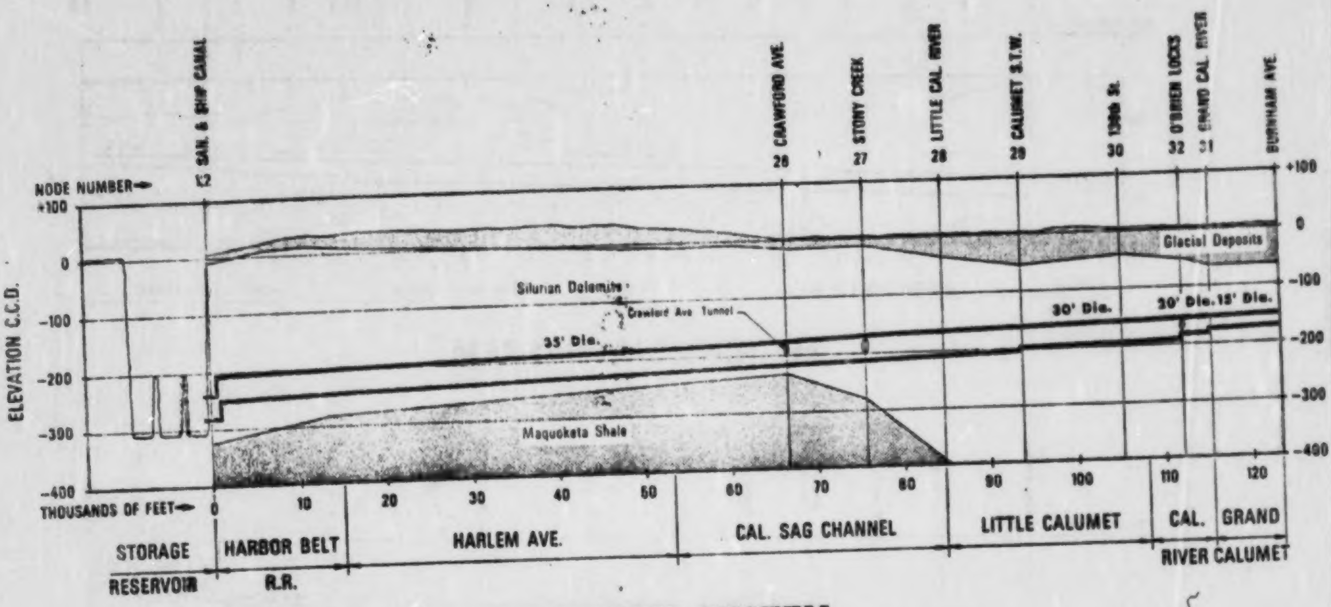
MAINSTREAM BRANCHES


18' Dia.
15' Dia.
Silurian Dolomite
SALT CREEK BRANCH
ADDISON CREEK
FEEHANVILLE DITCH

DES PLAINES RIVER BRANCHES

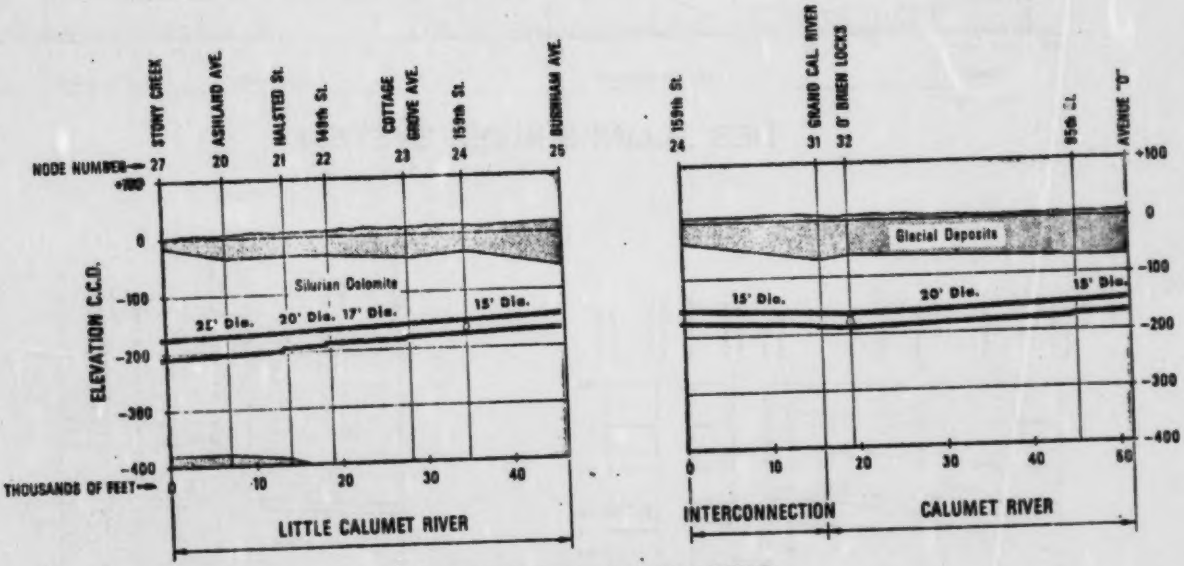
TUNNEL PROFILES

FIGURE M-X-3



NODE NUMBER
SAN. & SHIP CANAL
12
CRAWFORD AVE.
26
STONY CREEK
27
LITTLE CAL. RIVER
28
CALUMET S.T.W.
29
130th St.
30
O'BRIEN LOCKS
32
GRAND CAL. RIVER
31
BURNHAM AVE.
ELEVATION C.C.D.
+100
0
-100
-200
-300
-400
Glacial Deposits
Silurian Dolomite
Crawford Ave. Tunnel
35' Dia.
30' Dia.
20' Dia.
15' Dia.
Maquoketa Shale
THOUSANDS OF FEET
0
10
20
30
40
50
60
70
80
90
100
110
120
STORAGE RESERVOIR
HARBOR BELT R.R.
HARLEM AVE.
CAL. SAG CHANNEL
LITTLE CALUMET
CAL. RIVER
GRAND CALUMET

CALUMET SYSTEM

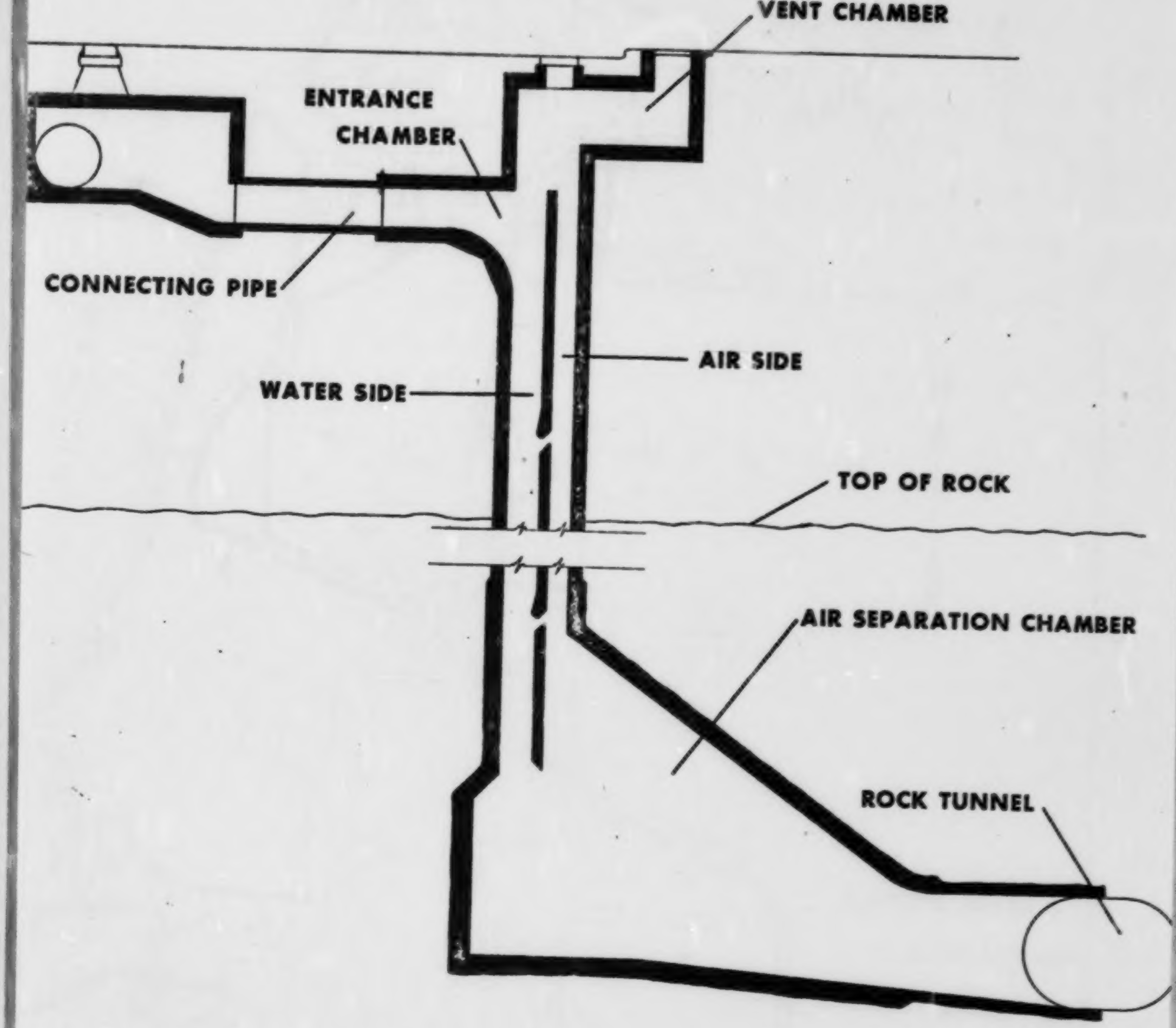


NODE NUMBER
STONY CREEK
27
ASHLAND AVE.
20
HALSTED St.
21
149th St.
22
COTTAGE GROVE AVE.
23
159th St.
24
BURNHAM AVE.
25
ELEVATION C.C.D.
+100
0
-100
-200
-300
-400
Silurian Dolomite
21' Dia.
20' Dia.
17' Dia.
15' Dia.
THOUSANDS OF FEET
0
10
20
30
40
LITTLE CALUMET RIVER
159th St.
24
GRAND CAL. RIVER
31
O' BRIEN LOCKS
32
95th St.
AVENUE "O"
Glacial Deposits
15' Dia.
20' Dia.
15' Dia.
0
10
20
30
40
50
INTERCONNECTION
CALUMET RIVER

CALUMET BRANCHES

TUNNEL PROFILES

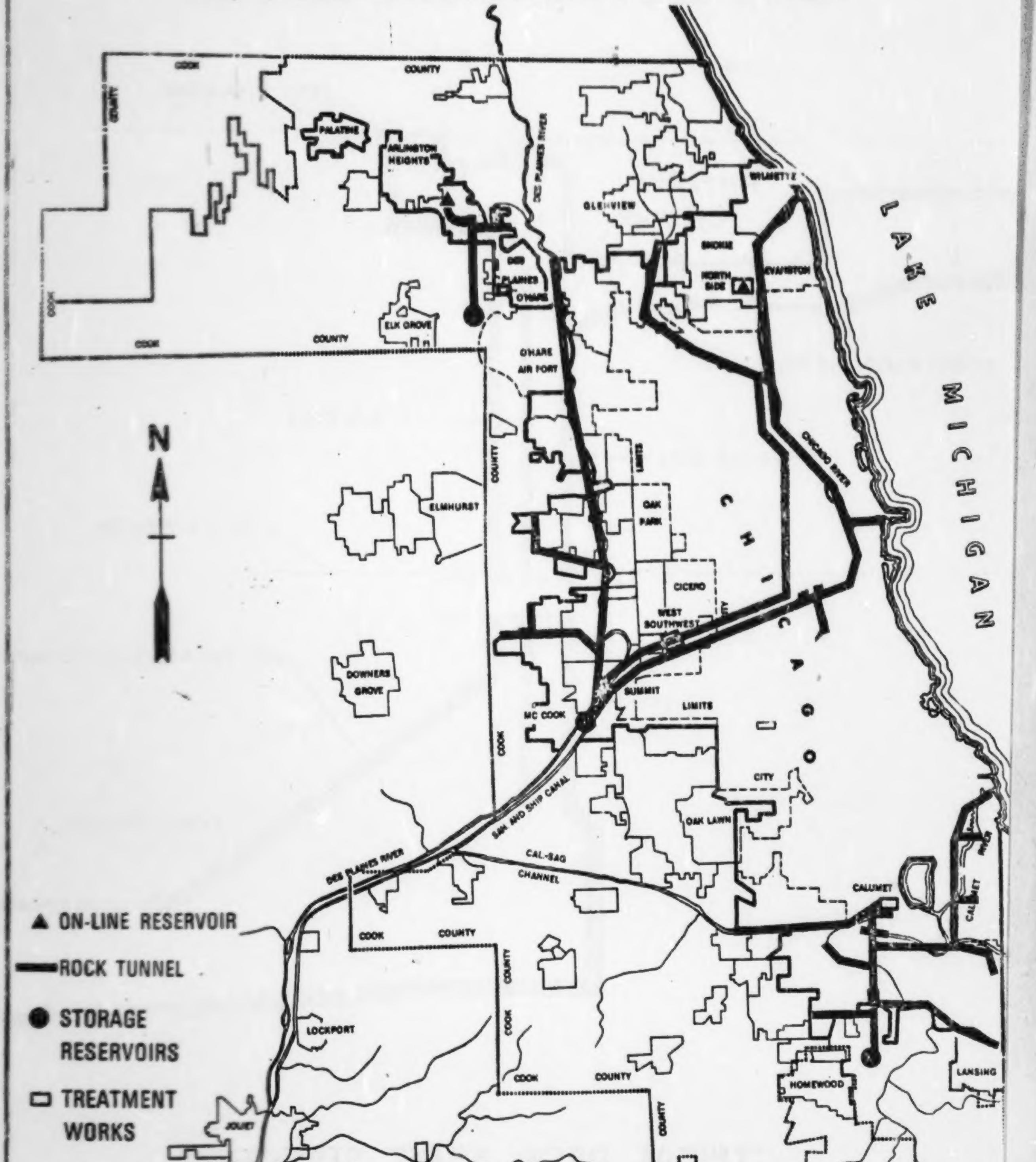
FIGURE M-X-4


VENT CHAMBER
ENTRANCE CHAMBER
CONNECTING PIPE
AIR SIDE
WATER SIDE
TOP OF ROCK
AIR SEPARATION CHAMBER
ROCK TUNNEL

TYPICAL DROP SHAFT STRUCTURE

FIGURE M-X-5

TUNNEL AND RESERVOIR PLAN


COOK COUNTY
PALATINE
ARLINGTON HEIGHTS
DES PLAINES RIVER
DES PLAINES
O'HARE
ELK GROVE
O'HARE AIR PORT
GLENVIEW
WILMETTE
SKOKIE
NORTH SIDE
EVANSTON
LAKE MICHIGAN
CHICAGO RIVER
CHICAGO CITY LIMITS
N
ELMHURST
OAK PARK
CICERO
WEST SOUTHWEST
SUMMIT
MC COOK
DOWNERS GROVE
SAN AND SHIP CANAL
CAL-SAG CHANNEL
DES PLAINES RIVER
OAK LAWN
CALUMET
LOCKPORT
JOLIET
HOMEWOOD
LANSING
▲ ON-LINE RESERVOIR
ROCK TUNNEL
● STORAGE RESERVOIRS
☐ TREATMENT WORKS

B-20

FIGURE M-X-6

(44)

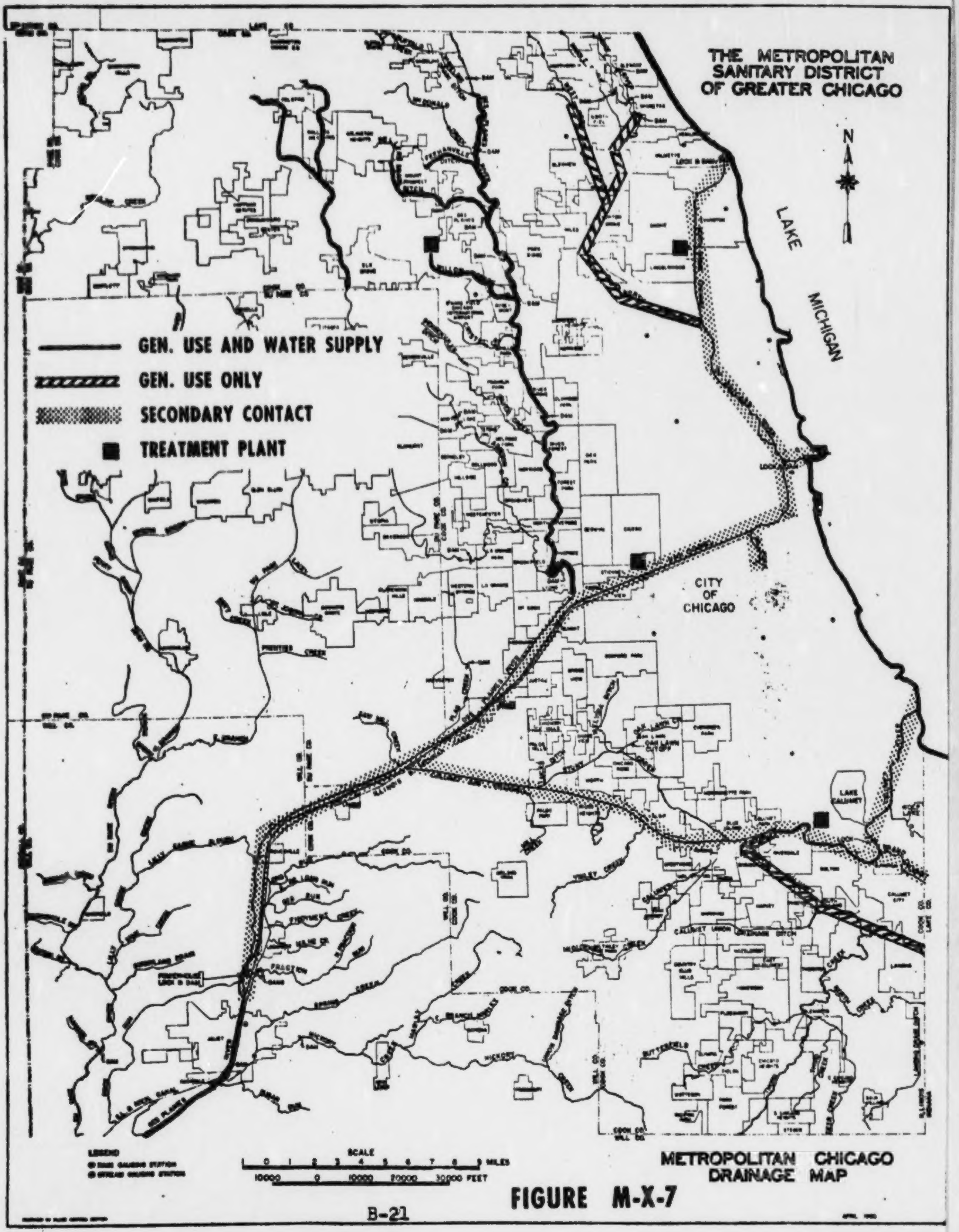
THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
N
LAKE MICHIGAN
CITY OF CHICAGO
LAKE CALUMET
GEN. USE AND WATER SUPPLY
GEN. USE ONLY
SECONDARY CONTACT
TREATMENT PLANT
SCALE
0 1 2 3 4 5 6 7 8 9 MILES
10000 0 10000 20000 30000 FEET
METROPOLITAN CHICAGO DRAINAGE MAP

FIGURE M-X-7

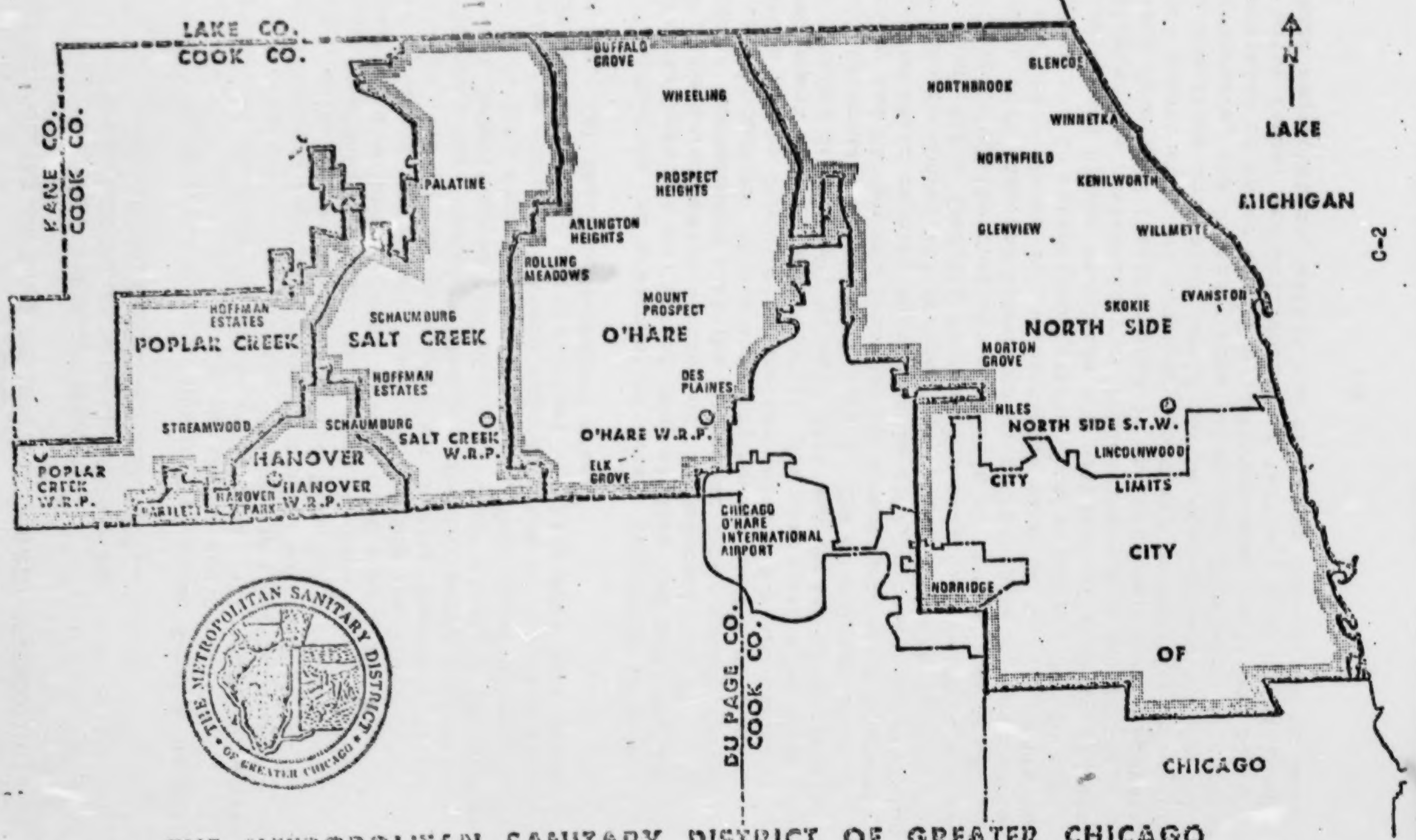
APPENDIX C
THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

POSITION PAPER ON SELECTION OF UPPER DESPLAINES SERVICE BASIN PLAN OVER OTHER SUGGESTED ALTERNATES

The O'Hare Facility Area (Upper DesPlaines Service Basin) is a 58 square mile area in the northwest region of the Metropolitan Sanitary District. At present, all sanitary sewage and the combined sewage finding its way into District interceptors through regulated control structures, is diverted through existing interceptors to the District's Northside Sewage Treatment Works for treatment. Initially, following annexation into the District of most of the area in 1956, it was planned to transmit sewage flows for the District's northwest area to the West-Southwest Sewage Treatment Plant in Stickney for treatment. However, further study indicated the cost-effectiveness and desirability of dividing the northwest area into four (4) service areas. This Paper gives, in detail, the planning history and rationale of dividing the northwest area of which the O'Hare Facility Area is a part, into four (4) facility (service) areas.

Collection and treatment of sewage generated in this basin has been the subject of many studies and reports. In 1961, the Sewer Design Section of the Metropolitan Sanitary District recommended that the Northwest Intercepting System be constructed to relieve existing sewers in the northwest portion of the District to provide service for the ultimate development of that area (Ref.1). The northwest area comprises the O'Hare, Salt Creek, Hanover Park and Poplar Creek (Elgin) Facility Areas as shown in Figure 1. The consulting firm of Greeley and Hansen was retained to investigate this proposal. Based on their report, submitted in 1962, a tentative decision was made to convey all sewage from the area to the West-Southwest Treatment Plant (Ref.2). Further investigation of this proposal indicated that the cost and magnitude of the project would require such time and resources as to necessitate construction of temporary plants in the northwest area (Refs.1,2). Additional studies and investigations carried out primarily due to the trend toward higher standards for disposal of treated effluent, indicated the advisability of collecting and treating the sewage from each facility area in the northwest area separately, since construction of temporary tertiary treatment plants, of the magnitude indicated, would not be cost-effective (Ref.3). Furthermore, the District considered that diversion of substantial quantities of water from the northwest area would not be conducive to water reuse. The utilization of tertiary quality effluents for stream augmentation, within the area, was considered to have

NORTHWEST REGION – SERVICE AREAS


LAKE CO.
COOK CO.
KANE CO.
COOK CO.
N
LAKE
MICHIGAN
PALATINE
BUFFALO GROVE
WHEELING
PROSPECT HEIGHTS
ARLINGTON HEIGHTS
ROLLING MEADOWS
MOUNT PROSPECT
O'HARE
DES PLAINES
O'HARE W.R.P.
ELK GROVE
HOFFMAN ESTATES
POPLAR CREEK
SCHAUMBURG
SALT CREEK
HOFFMAN ESTATES
STREAMWOOD
SCHAUMBURG
SALT CREEK W.R.P.
HANOVER
HANOVER W.R.P.
HANOVER PARK
BARTLETT
POPLAR CREEK W.R.P.
NORTHBROOK
BLENCOE
WINNETKA
NORTHFIELD
KENILWORTH
GLENVIEW
WILLMETTE
SKOKIE
EVANSTON
NORTH SIDE
MORTON GROVE
NILES
NORTH SIDE S.T.W.
LINCOLNWOOD
CITY
LIMITS
CHICAGO O'HARE INTERNATIONAL AIRPORT
NORRIDGE
CITY
OF
CHICAGO
DU PAGE CO.
COOK CO.

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO environmental and recreational benefits. The Northwest Intercepting Sewer proposal would have diverted all sewage flows from the area for treatment at West-Southwest Treatment Plant and treated effluent would be discharged into the Sanitary and Ship Canal at Stickney.

As a consequence, the Northwest Area was divided into Facility Areas corresponding to existing drainage basins: Upper DesPlaines Service Basin, O'Hare Facility Area; Upper Salt Creek Service Basin, Salt Creek Facility Area; Upper DuPage Service Basin, Hanover Park Facility Area; and Poplar Creek Service Basin, Poplar Creek (Elgin) Facility Area.

A preliminary design concept for the O'Hare Water Reclamation Plant and intercepting sewers was prepared in report form by Brown and Caldwell, consulting engineers, in 1968 (Ref.4). The contract plans for O'Hare Water Reclamation Plant have been prepared by Consoer, Townsend and Associates, consulting engineers, and are presently under review by the District. Preliminary plans for two (2) collection facilities systems were prepared in a report by DeLeuw, Cather & Company, consulting engineers (Ref.5). One system would divert total sanitary sewage flow only within the basin to the O'Hare Water Reclamation Plant; the second system would convey all sanitary sewage to the plant but would, in addition, eliminate combined sewer overflows by collecting and storing for treatment, all combined sewer overflows presently discharging to waterways within the drainage area. They are presently developing contract plans for the O'Hare Tunnel System as part of the second system.

In 1973, The Corps of Engineers published the Chicago-South End of Lake Michigan Study (Ref.6). The investigation included the O'Hare Facility Area and the O'Hare Water Reclamation Plant was defined in three of the five alternates presented in the Report.

Northeastern Illinois Planning Commission (NIPC) included the District's plan for the O'Hare Facility Area in its "Regional Wastewater Plan" in 1971 (Ref.7). This plan has been revised a number of times since (Refs.8,9,10,11,12) but revisions have not affected the O'Hare Facility Area except to include the District's Tunnel and Reservoir Plan as a regional solution to the combined sewer overflow problem. The first three NIPC Plan revisions have been certified by the State of Illinois and the Federal Government in accordance with 40 CFR 35.565 (Refs.8,9,10).

The review of the planning history indicates that the division of the District's Northwest area into four facility areas is cost-effective and environmentally sound and has been recognized by NIPC, the State of Illinois and the Federal Government. The District's comprehensive plan calls for collection and treatment of sewage within each facility area separately. For the O'Hare Facility Area, the District has planned a collection system designated as O'Hare Tunnel System and a treatment facility, O'Hare Water Reclamation Plant.

It is, therefore, clear that the selection of the Upper DesPlaines Service Basin Plan over other alternates suggested was a sound judgment, based on a number of detailed engineering studies concurred in by a multitude of governmental agencies. Based on the results of the studies and concurrence of the applicable regulatory and planning agencies, as well as the majority of the affected communities, decisions have been made and actions taken over a number of years which weigh even more heavily in favor of continuing the proposed course of action as expeditiously as possible. The initiation of new studies and reconsideration of numerous alternates suggested by individuals untrained in the relevant fields of endeavor and uninformed in the history of past decisions and the multitude of facts and data drawn upon in making these decisions is unwarranted.

REFERENCES:

1. MSDGC, "Recommendation for Site Acquisition for Additional Sewage Treatment Plants for Northwest Section of Cook County, Salt Creek and DesPlaines River Areas," June 25, 1964

2. Greeley and Hansen, "Proposed West and Northwest Sewers," MSDGC, 1962

3. Greeley and Hansen, "Report for Northwest Area", MSDGC, 1968

4. Brown and Caldwell, "Design Report, O'Hare Reclamation Plant", MSDGC, 1968

5. DeLeuw, Cather & Company, "Preliminary Plans for O'Hare Collection Facility", MSDGC, 1972

6. Corps of Engineers, "Chicago South End of Lake Michigan Study", Chicago District, 1974

7. Northeastern Illinois Planning Commission, "Regional Wastewater Plan", March, 1971

8. Northeastern Illinois Planning Commission, "Regional Wastewater Plan", Revised September, 1971

9. Northeastern Illinois Planning Commission, "Regional Wastewater Plan", Revised October, 1971

10. Northeastern Illinois Planning Commission, "Regional Wastewater Plan", Revised January, 1972

11. Northeastern Illinois Planning Commission, "Regional Wastewater Plan", Revised July, 1972

12. Northeastern Illinois Planning Commission, "Regional Wastewater Plan", Revised October, 1972

APPENDIX D

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION V
230 SOUTH DEARBORN STREET
CHICAGO, ILLINOIS 60604

January 16, 1975

Dear Sir:

Region V of the USEPA is initiating the preparation of a draft Environmental Impact Statement for the proposed O'Hare Water Reclamation Plant in Des Plaines, Illinois.

Much of the public opposition to the proposed treatment facility has focused on the potential health hazard of locating a sewage treatment plant in close proximity to a residential neighborhood. We want to determine the present state of knowledge of the health significance of airborne bacteria, viruses, and gaseous chemical compounds which may be emitted from uncovered sewage treatment plants of this size and process.

Attached is a brief description of the proposed project with accompanying maps illustrating the wastewater facility design layout, the site location and other relevant background information.

To aid in our environmental impact evaluation, we would like you to address the following questionnaire. We are interested in your own research experiences with these topics and in any relevant references to the scientific literature that you can identify. To incorporate the results of this questionnaire into the draft Environmental Impact Statement, we need to have your response by February 3, 1975.

If you have any questions concerning this project, please contact Dale Luecht or Cathy Grissom of my staff at 312-353-7730. Thank you for your help.

Sincerely yours,

Harlan D. Hirt

Harlan D. Hirt
Chief, Planning Branch

Enclosures
a/s

Questionnaire

1. Are any synergistic effects known between airplane related emissions and aerosols or gases generated by activated sludge treatment processes? If so, what are these effects?

2. What epidemiological studies have been conducted on the health of sewage treatment plant workers or residents in the area of a treatment facility? What do the results indicate?

3. In your opinion, is there any significant health hazard associated with siting a wastewater treatment plant of this size and process type in this location? Why or why not?

4. In your opinion, will there be any significant odor problems associated with the operation of a facility such as this? Why or why not?

5. Is there a minimum distance and/or special protective measures which should be incorporated into the design of a treatment plant such as this to protect the workers and the adjacent residential communities from any potential health hazard?

6. In your opinion, would a wastewater reclamation plant of this size and process type produce significant quantities of chemical emissions of a corrosive or abrasive nature? Discuss the reasons why you feel this will or will not be a problem.

7. Are you aware of any other comparable situations where similar issues occurred? What were these issues and how were they resolved?

Sent January 20, 1975

Dr. G. J. Love
Human Studies Laboratory
EPA, National Environmental
Research Center
Research Triangle Park, N.C. 27711

Dr. Flora Mae Wellings
Epidemiological Research Center
4000 W. Buffalo Avenue
Tampa, Florida 33614

813-876-1351

George F. Mallison, Asst. Dir.
Bacterial Diseases Division
Center for Disease Control
1600 Clifton Road
Atlanta, Georgia 30333

404-633-3311

Dr. Peter Skaliy, Deputy Chief
Microbial Control Branch
Bureau of Epidemiology
Center for Disease Control
1600 Clifton Road
Atlanta, Georgia 30333

Dr. J. E. Quon
Dept. of Civil Engineering
Northwestern University
Evanston, Illinois 60201

Dr. Cecil Lue-Hing
Director of Research & Development
Metropolitan Sanitary District of
Greater Chicago
100 East Erie
Chicago, Illinois 60611

Dr. Blumenthal, Chairman
Department of Microbiology
Loyola University
Stritch School of Medicine
Maywood, Illinois 60153

Dr. Lawrence Wang
Argonne National Laboratory
Building 12
9700 South Cass Avenue
Argonne, Illinois 60439

Dr. Lee McCabe, Chief
Criteria Development Branch
Water Supply Research Laboratory
National Environmental Health Center
Cincinnati, Ohio 45268

Dr. Paul Kenline
EPA, National Environmental Research
Center - R.I.P.
Room M-311
Research Triangle Park, N.C. 27711

John Convery
Advanced Waste Treatment Research Lab.
National Environmental Research Center
4676 Columbia Parkway
Cincinnati, Ohio 45268

Dr. Robert Bunch, Chief
Treatment Process Development Branch
Advanced Waste Treatment Research Center
National Environmental Research Center
4676 Columbia Parkway
Cincinnati, Ohio 45268

Dr. Gerald Berg, Chief
Biological Methods Branch
M.D.Q.A.R.L.
National Environmental Research Center
4676 Columbia Parkway
Cincinnati, Ohio 45268

Edward Barth
A.W.T.R.L.
National Environmental Research Center
4676 Columbia Parkway
Cincinnati, Ohio 45268

Mrs. Edie Tomkins
Human Studies Laboratory
EPA National Environmental Research Center
Research Triangle Park, N.C. 27711

Dr. Hutton D. Slade
Department of Microbiology
Northwestern School of Medicine
303 East Chicago
Chicago, Illinois 60611

Valdas Adamkus, Deputy Reg. Adminis.
Region V

Clifford Risley,Jr., R & D.
R egion V

Project Description

The proposed O'Hare Water Reclamation Plant is a 72 MGD facility serving a suburban Chicago population in Des Plaines, Mt. Prospect, Elk Grove, Rolling Meadows, Arlington Heights, Prospect Heights, Wheeling, and Buffalo Grove, Illinois. The present population of the service area is 250,000. The projected population in the design year is 300,000. The ultimate size of this facility is anticipated to be 96 MGD. Wastewater characteristics and flow projections are tabulated in enclosure C. No unusual industrial wasteloadings are anticipated in the service area.

The sewage conveyance system consists of laterals, connections to existing sewer lines, drop shafts and tunnels. The tunnels are to be located 40 to 160 feet below the surface and are 5' to 20' in diameter. Both combined sewage (approximately 20% of the service area) and sanitary sewage will be conveyed to the treatment plant by this system. The tunnels have a total volume of 200 acre feet providing storage capacity and should reduce combined sewage overflows in the service area from approximately 80 to 6 a year.

In the two stage treatment process, carbonaceous biochemical oxygen demand (BOD) and ammonia nitrogen are removed in two separate sets of aeration and sedimentation tank modules. (Aeration tanks cover approximately 6.6 acres for the 72 MGD facility and an additional 2 acres at 96 MGD). Final effluent polishing and disinfection are to be accomplished by dual media filters and the injection of sodium hypochlorite. Post aeration will raise the dissolved oxygen content of the effluent before it is discharged to Higgins Creek. Sludge will be piped to the Salt Creek facility, at another location, for treatment.

The 104 acre proposed treatment plant site is bounded by an industrial area and abandoned gravel pit to the east, a commercial area to the west, and a toll road to the south. Residential areas are located immediately to the north of the site and on the south side of the tollway. Homes are within 400 feet from the north edges of the aeration tanks. (See enclosure D-2 and D-3).

List of Enclosures

A. Climate - O'Hare Airport
B. Air Quality - Data presented at public hearing
C. Influent Wastewater Characteristics and process flow diagram
D. Maps
    1. Chicago area
    2. Air photo - treatment plant site
    3. Map - treatment plant site
    4. Treatment plant layout

E. Conveyance System

Enclosure A

Climate - O'Hare International Airport

1. Annual Summary, Local Climatological Data, 1973, U.S. Dept. of Commerce.
2. Summary of Hourly Observations, 1956-1960, U.S. Dept. of Commerce.
3. Annual and Monthly Wind Roses based on hourly observations, 1956-1960, U.S. EPA.

   Concentric circles represent composite percent frequencies.

   These wind roses were developed from table B, Summary of Hourly Observations, 1956-1960.

A UNITED STATES
DEPARTMENT OF
COMMERCE
PUBLICATION

LOCAL CLIMATOLOGICAL DATA
ANNUAL SUMMARY WITH COMPARATIVE DATA

CHICAGO, ILLINOIS
O'HARE INTERNATIONAL AIRPORT

1973

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
ENVIRONMENTAL DATA SERVICE

NARRATIVE CLIMATOLOGICAL SUMMARY

Chicago is along the southwest shore of Lake Michigan and occupies a plain which, for the most part, is only some tens of feet above the lake. Lake Michigan averages 579 feet above m. s. l. Natural water drainage over most of the City would be into Lake Michigan, and from areas west of the City is into the Mississippi River system. But actual drainage over most of the City is artificially channeled also into the Mississippi system.

Topography does not significantly affect air flow in or near the City except that lesser frictional drag over Lake Michigan causes winds to be frequently stronger along the lake shore, and often permits airmasses moving from the north to reach shore areas an hour or more before affecting western parts of the City.

Chicago is in a region of frequently changeable weather. The climate is predominantly continental, ranging from relatively warm in summer to relatively cold in winter. However, the continentality is partially modified by Lake Michigan, and to a lesser extent by other Great Lakes. In late autumn and winter, airmasses that are initially very cold often reach the City only after being tempered by passage over one or more of the lakes. Similarly, in late spring and summer, airmasses reaching the City from the north, northeast, or east are cooler because of movement over the Great Lakes. Very low winter temperatures most often occur in air that flows southward to the west of Lake Superior before reaching the Chicago area. In summer the higher temperatures are with south or southwest flow and are therefore not influenced by the lakes, the only modifying effect being a local lake breeze. Strong south or southwest flow may overcome the lake breeze and cause high temperatures to extend over the entire City.

During the warm season, when the lake is cold relative to land, there is frequently a lake breeze that reduces daytime temperature near the shore, sometimes by 10° or more below temperatures farther inland. When the breeze off the lake is light this effect usually reaches inland only a mile or two, but with stronger on - shore winds the whole City is cooled. On the other hand, temperatures at night are warmer near the lake so that 24 - hour averages on the whole are only slightly different in various parts of the City and suburbs.

In summer a combination of high temperature and humidity may develop, usually building up progressively over a period of several days when winds continue out of the south or southwest, becoming oppressive for one or perhaps several days, then ending abruptly with a shift of winds into northwest or northerly. The change may be preceded or accompanied by thundershowers. High relative humidity often results from wind flow off the lake, but the air is then cooler and not oppressive.

At the O'Hare International Airport temperatures of 96° or higher occur in about half of the summers while about half of the winters have minima as low as - 15°. The average date of the first temperature as low as 32° in the fall is October 12 and the average date of the temperature as low as 32° in the spring is April 29 (1959 - 1972 data). However, temperatures this low have occurred as early as September 28 in autumn, and as late as May 29 in spring. Normal daily mean temperatures are below 32° for 96 days during winter. The normal heating season is from mid - September to early June. Ninety - four percent of the normal heating load is between October 1 and April 30, and 55 percent during the winter months of December through February. The normal air - conditioning season lasts from about mid - June to early September.

Precipitation falls mostly from air that has passed over the Gulf of Mexico. But in winter there is sometimes snowfall, light inland but locally heavy near the lake shore, with Lake Michigan as the principal moisture source. The heavy lake - shore snow accurs when initially colder air moves from the north with a long trajectory over Lake Michigan and impinges on the Chicago lake shore. In this situation the airmass is warmed and its moisture content increased up to a height of several thousand feet. Snowfall is produced by upward currents that become stronger, because of frictional effects, when the air moves from the lake onto land. This type of snowfall therefore tends to be heavier and to extend farther inland in south - shore areas of the City and in Indiana suburbs, where the angle between wind - flow and shoreline is greatest. The effect of Lake Michigan, both on winter temperatures and lake-produced snowfall, is enhanced by non-freezing of much of the lake during winter, even though shore areas and harbors are often ice-choked. This type of local heavy snowfall may occur once or a few times in a normal season.

Summer thundershowers are often locally heavy and variable; parts of the City may receive substantial rainfall and other parts none. Longer periods of continous precipitation are mostly in autumn, winter, and spring. About one-half the precipitation in winter, and about 10 percent of the yearly total precipitation falls as snow. Snowfall from month to month and year to year is greatly variable. There is a 50 percent likelihood that the first and last 1 - inch snowfall of a season will occur by December 5 and March 20, respectively. The corresponding dates for the first and last 3 - inch snowfall are December 24 and March 2. Freezing rain sometimes occurs but is usually light. During the cold season slight melting and refreezing of precipitation is a fairly common hazard to highway traffic.

Channeling of winds between tall buildings often causes locally stronger gusts in the central business area. Also winds are often locally more brisk along the shoreline; otherwise the nickname "windy city" is a misnomer, because the average wind speed is not greater than in many other parts of the United States.

Fog is infrequent. Visibility is much more often restricted by local air pollution, a condition that is worst during the heating season, but which continues throughout the year because of extensive industrial activity. For much of the time in autumn, winter, and spring, smoke and other air pollution is carried away by winds, sometimes rapidly, but on some occasions when there is little or no wind the pollution accumulates, especially during night and early morning hours. Summertime air pollution is less, partly because of lesser output, but also because of better vertical dispersal; on the other hand, on many summer days surface wind flow converges into the City, preventing or lessening horizontal outflow at the ground.

The amount of sunshine is moderate in summer and quite low in winter. A considerable amount of cloudiness, especially in winter, is locally produced by lake effect. Days in summer with no sunshine are rare. The total sunshine in December, partly because of shorter days, is only a little over one-third the July total.

METEOROLOGICAL DATA FOR THE CURRENT YEAR

Station: CHICAGO, ILLINOIS O HARE INTERNATIONAL AIRPORT Standard time used: CENTRAL Latitude: 41° 59' N Longitude: 87° 54' W Elevation (ground): 658 feet Year: 1975

Month	Temperature: Averages: Daily maximum	Daily minimum	Monthly	Extremes: Highest	Date	Lowest	Date	Degree days (Base 65°): Heating	Cooling	Precipitation: Total	Greatest in 24 hrs.	Date	Snow, Ice pellets: Total	Greatest in 24 hrs.	Date	Relative humidity: Hour 00	Hour 06	Hour 12	Hour 18	Wind: Resultant: Direction	Speed	Average speed	Fastest mile: Speed	Direction	Date	Percent of possible sunshine	Average sky cover sunrise to sunset	Number of days: Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog	Temperatures: Maximum: 90° and above	32° and below	Minimum: 32° and below	0° and below	Average daily solar radiation - langleys
JAN	29.3	21.0	25.2	57	26+	0	10	1139	0	1.26	0.62	3	0.5	0.5	23	79	81	68	74	24	5.1	11.4	33	25	1		6.9	8	3	20	6	0	0	1	0	12	23	1	
FEB	33.2	22.1	27.7	50	4	2	17+	1012	0	1.38	0.74	16	9.3	6.2	14-15	81	84	67	75	31	1.1	10.8	29	31	21		7.2	5	5	18	7	3	1	2	0	8	24	0	
MAR	41.5	30.1	36.0	75	14	22	22+	885	0	3.91	0.86	31	3.6	3.6	16-17	80	83	66	71	05	2.7	10.0	30	07	31		7.5	6	4	21	10	2	3	6	0	0	9	0	
APR	56.9	39.4	48.2	77	23	23	11	503	5	4.99	1.41	30	0.2	0.2	10	78	82	61	66	10	0.7	12.1	33	08	9+		7.3	5	7	18	13	0	4	2	0	0	7	0	
MAY	66.5	49.6	58.0	87	31	33	3	311	4	3.65	1.15	26-27	T	T	14	79	84	61	62	22	1.8	11.1	37	27	10		7.4	4	8	19	19	0	6	4	0	0	0	0	
JUN	80.8	61.5	71.2	95	11	50	25	9	189	2.07	1.39	16-17	0.0	0.0		77	86	57	56	22	3.3	9.2	26	05	16		5.5	7	13	10	10	0	6	1	2	0	0	0	
JUL	83.5	65.9	74.7	95	13	55	10	0	306	5.27	1.63	20-21	0.0	0.0		78	81	55	60	25	2.1	8.9	28	35	3		5.7	9	11	11	11	0	8	0	4	0	0	0	
AUG	83.2	65.9	74.6	95	27	57	3	0	301	6.67	2.36	23-26	0.0	0.0		86	86	60	63	20	2.6	8.7	23	03	14+		4.9	11	13	7	9	0	5	0	4	0	0	0	
SEP	70.3	57.2	63.8	93	3	43	18	72	108	6.01	2.16	26-29	0.0	0.0		82	87	58	66	19	0.5	8.9	29	23	4		6.8	7	6	17	16	0	5	1	3	0	0	0	
OCT	67.7	48.0	57.9	82	11	34	17	244	32	2.88	1.21	12-13	0.0	0.0		82	87	62	69	22	4.0	9.3	30	20	12		5.9	7	11	13	9	0	2	2	0	0	0	0	
NOV	50.5	33.6	41.9	65	16	18	10	687	0	1.30	0.52	14-15	T	T	28+	82	86	65	72	26	3.5	11.0	33	16	21		7.3	3	5	20	11	0	1	2	0	0	9	0	
DEC	34.3	21.6	28.1	64	3	2	31+	1139	0	3.71	1.12	4-5	16.6	6.7	15-16	82	85	73	77	29	1.4	11.5	32	16	4		8.3	1	8	22	17	3	1	1	0	14	26	0	
YEAR	59.4	43.1	51.3	95	AUG. 27+	0	JAN. 10	5748	946	38.10	2.16	SEP. 24-25	32.2	6.7	DEC. 15-16	80	85	63	68	23	1.6	10.2	37	27	MAY 10		6.7	73	94	196	142	10	40	24	13	30	100	1	

NORMALS, MEANS, AND EXTREMES

Month	Temperature ∮: Normal: Daily maximum	Daily minimum	Monthly	Extremes: Record highest	Year	Record lowest	Year	Normal heating degree days (Base 65°)	Precipitation ∮: Normal total	Maximum monthly	Year	Minimum monthly	Year	Maximum in 24 hrs.	Year	Snow, Ice pellets: Mean total	Maximum monthly	Year	Maximum in 24 hrs.	Year	Relative humidity: Hour 00	Hour 06	Hour 12	Hour 18 (Local time)	Wind ∆ ∮: Mean speed	Prevailing direction	Fastest mile: Speed	Direction	Year	Pct. of possible sunshine	Mean sky cover sunrise to sunset	Mean number of days: Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, Ice pellets 1.0 inch or more	Thunderstorms	Heavy fog	Temperatures: Max.: 90° and above	32° and below	Min.: 32° and below	0° and below	Average daily solar radiation - langleys
(a)	(b)	(b)	(b)	19		19		(b)	(b)	19		19		19		19	19		19		19	19	19	19	19		15	15			19	15	15	15	15	15	15	15	15	15	15	15	
J	31.1	14.7	22.9	61	1967	-20	1966	1305	1.70	4.11	1965	0.27	1961	2.00	1960	10.2	25.1	1967	18.1	1967	73	77	67	72	11.3		47	28	1971		6.7	7	7	17	10	3	0	2	0	16	29	7	
F	34.3	17.8	26.1	62	1972	-17	1967	1089	1.30	2.70	1960	0.12	1969	1.00	1960	7.9	21.5	1967	8.4	1967	74	76	65	69	11.4		45	25	1967		6.7	7	5	16	10	2	0	2	0	13	26	3	
M	44.6	26.7	35.7	88	1963	-8	1962	908	2.58	4.01	1961	0.90	1968	1.85	1972	8.8	24.7	1965	10.6	1970	76	79	61	63	11.8		46	01	1964		7.3	5	9	17	13	2	2	3	0	4	22	0	
A	59.4	38.2	48.8	88	1970+	14	1972	486	3.38	6.28	1966	0.97	1971	2.36	1972	1.5	7.2	1970	7.2	1970	72	77	55	57	12.1		54	24	1965		6.8	6	8	16	13	0	4	1	0	0	8	0	
M	69.7	47.8	58.8	92	1967+	24	1966	240	3.41	7.14	1970	1.61	1967	2.91	1966	0.1	1.0	1966	1.0	1966	72	76	54	54	10.8		52	34	1962		6.3	7	10	14	11	0	5	1	0	0	1	0	
J	79.1	57.9	68.1	97	1971	38	1972+	43	4.15	7.94	1967	1.68	1959	3.09	1967	0.0	0.0		0.0		74	79	55	55	9.8		41	24	1970+		5.9	8	11	11	10	0	7	1	4	0	0	0	
J	83.1	60.7	71.9	97	1966	40	1965	7	3.46	8.27	1972+	1.87	1967	2.89	1962	0.0	0.0		0.0		79	82	58	58	7.9		52	32	1959		5.6	9	13	9	10	0	6	1	6	0	0	0	
A	82.3	59.9	71.1	98	1964	41	1965+	18	2.73	6.97	1972	0.81	1969	3.64	1968	0.0	0.0		0.0		80	85	57	62	8.0		46	32	1960		5.6	10	12	9	7	0	5	1	5	0	0	0	
S	73.6	52.0	63.7	99	1960	32	1966	90	3.01	11.44	1961	0.55	1966	2.92	1961	T	T	1967	T	1967	82	85	58	64	8.6		56	23	1959		6.0	8	10	12	11	0	5	0	2	0	0	0	
O	65.5	42.0	53.8	91	1963	19	1962	360	2.32	6.55	1969	0.10	1964	6.62	1969	0.5	6.6	1967	6.6	1967	76	82	56	64	9.5		48	20	1971		5.8	9	9	13	9	0	2	1	0	0	3	0	
N	48.3	30.1	39.2	77	1971+	1	1958	774	2.10	4.74	1966	0.71	1962	1.76	1960	1.5	10.4	1959	3.3	1959	77	81	63	70	10.8		51	23	1958		7.2	4	6	18	9	1	1	2	0	2	16	0	
D	35.0	19.2	27.1	67	1970	-17	1960	1175	1.84	5.37	1971	0.23	1962	2.13	1971	8.3	19.3	1969	11.0	1969	79	81	70	69	10.8		46	26	1970+		7.3	5	7	19	11	2	0	2	0	11	26	3	
YR	59.0	38.8	48.9	99	SEP. 1960	-20	JAN. 1966	6497	31.72	11.44	SEP. 1961	0.12	FEB. 1969	6.62	OCT. 1969	39.0	25.1	JAN. 1967	18.1	JAN. 1967	76	80	60	63	10.2		56	23	SEP. 1959		6.6	87	107	171	124	11	37	17	13	30	133	13	

∮ Extremes for Period November 1958 through the current year.

Means and extremes above are from existing and comparable exposures. Annual extremes have been exceeded at other sites in the locality as follows: Highest temperature 105 in July 1934; lowest temperature -23 in December 1872; maximum monthly precipitation 14.17 in September 1961; minimum monthly precipitation 0.06 in February 1877; maximum monthly snowfall 42.5 in January 1918; fastest mile of wind 87 from Northeast in February 1894.

(a) Length of record, years, based on January data. Other months may be for more or fewer years if there have been breaks in the record.
(b) Climatological normals (1941-1970).
* Less than one half.
+ Also on earlier dates, months, or years.
T Trace, an amount too small to measure.
- Below zero temperatures are preceded by a minus sign.
∮ ≥ 70° at Alaskan stations.

The prevailing direction for wind in the Normals, Means, and Extremes table is from records through 1963.

Unless otherwise indicated, dimensional units used in this bulletin are: temperature in degrees F.; precipitation, including snowfall, in inches; wind movement in miles per hour; and relative humidity in percent. Heating degree day totals are the sums of negative departures of average daily temperatures from 65° F. Cooling degree day totals are the sums of positive departures of average daily temperatures from 65° F. Sleet was included in snowfall totals beginning with July 1948. The term "ice pellets" includes solid grains of ice (sleet) and particles consisting of snow pellets encased in a thin layer of ice. Heavy fog reduces visibility to 1/4 mile or less.

Sky cover is expressed in a range of 0 for no clouds or obscuring phenomena to 10 for complete sky cover. The number of clear days is based on average cloudiness 0-3, partly cloudy days 4-7, and cloudy days 8-10 tenths.

Solar radiation data are the averages of direct and diffuse radiation on a horizontal surface. The langley denotes one gram calorie per square centimeter.

∆ Figures instead of letters in a direction column indicate direction in tens of degrees from true North; i.e., 09 - East, 18 - South, 27 - West, 36 - North, and 00 - Calm. Resultant wind is the vector sum of wind directions and speeds divided by the number of observations. If figures appear in the direction column under "Fastest mile" the corresponding speeds are fastest observed 1-minute values.

CHICAGO, ILLINOIS
O'HARE INTERNATIONAL AIRPORT

AVERAGE TEMPERATURE

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1958											41.4	20.5	
1959	16.2	24.9	35.9	47.8	64.8	71.1	73.9	77.3	67.2	50.1	31.8	34.6	49.9
1960	26.0	24.8	24.4	52.1	57.7	66.9	72.1	73.7	68.4	54.0	41.7	23.5	48.5
1961	20.3	31.4	38.0	45.3	56.8	67.4	71.1	70.9	65.6	53.6	39.9	25.3	48.5
1962	16.0	24.4	33.1	48.8	65.0	67.9	69.2	71.8	60.7	55.0	40.1	25.2	48.1
1963	11.9	16.9	39.8	50.9	56.3	69.0	72.1	68.9	64.8	60.5	41.9	13.3	47.1
1964	27.7	20.6	35.7	49.1	62.7	69.8	72.1	67.7	63.3	48.0	41.4	24.7	48.9
1965	21.4	24.2	28.6	46.0	61.7	66.9	69.4	68.0	63.8	53.2	40.3	35.3	47.9
1966	14.3	26.1	39.6	45.2	53.4	68.3	76.2	69.6	62.5	51.4	42.5	27.1	48.1
1967	27.7	19.0	35.5	48.6	53.8	69.8	68.4	68.2	61.7	52.9	37.3	30.3	47.7
1968	23.0	23.6	42.7	52.3	57.0	70.2	72.0	73.7	65.5	54.7	40.0	27.8	50.3
1969	21.1	29.9	34.6	50.8	60.4	64.3	73.0	73.9	65.3	51.8	38.3	28.0	49.3
1970	16.5	26.1	34.6	51.7	61.9	69.4	74.7	72.9	65.2	55.4	40.7	30.8	50.0
1971	16.9	28.2	35.0	48.8	57.2	73.5	71.9	72.0	69.7	61.7	41.7	34.2	51.0
1972	19.0	23.6	34.0	46.8	61.0	65.7	73.6	73.8	63.5	49.3	37.7	23.9	47.6
1973	28.2	28.7	44.0	48.1	54.8	71.2	74.7	74.6	66.0	57.9	41.9	26.1	51.5
RECORD													
MEAN	20.8	23.3	33.9	48.6	58.8	68.6	72.1	71.6	64.9	54.0	39.9	26.9	48.9
MAX	28.7	33.2	45.9	58.4	69.7	79.5	87.2	82.0	75.3	64.3	48.1	34.2	58.3
MIN	12.9	17.2	27.1	38.7	47.0	57.6	61.9	61.2	56.5	43.6	31.0	19.5	39.5

HEATING DEGREE DAYS

Season	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
1958-59					701	1373	1309	1131	897	523	133	23	
1959-60	2	0	85	434	988	961	1175	1164	1247	407	243	33	6759
1960-61	2	3	94	346	691	1282	1377	933	830	640	332	53	6565
1961-62	15	11	128	360	747	1223	1489	1120	970	504	147	30	6770
1962-63	6	1	179	310	740	1291	1655	1339	776	425	281	39	7062
1963-64	16	24	86	176	684	1598	1149	1106	963	479	139	63	6483
1964-65 #	10	52	148	521	699	1240	1345	1134	1185	543	157	79	7113
1965-66	12	53	110	370	733	915	1302	1079	782	587	371	53	6367
1966-67	1	12	127	420	669	1170	1148	1257	878	491	362	19	6534
1967-68	39	53	160	395	827	1068	1274	1192	682	376	257	28	6351
1968-69	14	12	59	335	740	1146	1355	976	961	419	206	126	6345
1969-70	4	0	75	423	794	1138	1506	1086	929	410	168	46	6585
1970-71	2	0	83	302	725	1055	1422	1026	923	484	282	14	6300
1971-72	7	3	66	154	893	968	1405	1197	956	602	178	60	6285
1972-73	15	10	109	481	811	1268	1135	1012	645	303	311	0	6301
1973-74	0	0	72	244	687	1130							

TOTAL PRECIPITATION

Year	Jan.	Feb.	Mar	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1958											1.65	0.72	
1959	1.91	1.66	3.30	2.36	3.44	1.68	3.18	2.03	1.91	4.04	2.57	1.99	32.06
1960	3.07	2.70	1.17	3.03	2.44	4.06	4.27	3.46	1.39	1.33	0.81	0.48	28.20
1961	0.27	0.88	4.01	2.67	2.03	4.20	3.69	1.36	11.44	3.34	1.76	1.35	36.78
1962	2.36	1.18	1.39	1.14	3.20	2.15	3.27	1.62	1.30	0.69	0.71	0.23	21.77
1963	0.66	0.36	2.26	4.38	1.92	2.30	4.09	2.73	2.88	0.28	2.00	0.73	25.27
1964	0.78	0.32	3.45	3.22	2.26	2.06	4.23	1.95	3.96	0.10	2.90	1.31	29.74
1965	4.11	1.16	3.06	3.48	2.30	3.04	3.08	6.40	5.03	1.57	1.47	3.32	39.08
1966	1.06	1.79	2.04	4.28	4.77	2.93	2.19	1.00	0.55	2.10	4.74	1.88	32.00
1967	2.22	1.82	2.30	3.97	1.61	7.94	1.87	2.60	2.45	3.69	2.19	2.41	35.27
1968	1.77	0.87	0.90	2.31	2.99	4.15	2.03	5.72	3.88	1.04	3.70	2.77	31.73
1969	1.02	0.12	1.93	4.03	3.17	7.76	3.43	0.51	3.01	6.35	1.11	1.18	34.41
1970	0.82	0.39	2.12	4.29	7.14	7.14	4.08	1.50	8.69	2.48	2.78	1.77	43.40
1971	0.93	1.04	1.54	0.67	2.23	2.64	3.37	3.97	2.39	0.72	1.32	3.37	27.57
1972	1.01	0.75	3.65	4.77	3.02	3.33	4.97	6.97	8.14	2.92	3.05	2.89	45.47
1973	1.34	1.36	3.01	4.98	3.69	2.87	3.27	0.67	6.01	2.80	1.30	3.71	38.10
RECORD													
MEAN	1.88	1.18	2.30	3.62	3.10	3.98	3.89	2.80	4.22	2.20	2.13	2.02	33.30

TOTAL SNOWFALL

Season	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
1958-59					0.4	10.7	13.6	2.2	2.9	0.6	0.0	0.0	
1959-60	0.0	0.0	0.0	0.3	10.4	6.9	3.5	17.3	13.3	T	T	0.0	51.7
1960-61	0.0	0.0	0.0	0.0	0.1	4.2	3.0	6.5	2.4	6.9	0.0	0.0	23.1
1961-62	0.0	0.0	0.0	T	2.0	10.7	18.6	10.0	5.7	0.7	0.0	0.0	47.7
1962-63	0.0	0.0	0.0	T	0.3	2.3	16.8	8.4	7.5	T	0.0	0.0	35.3
1963-64	0.0	0.0	0.0	0.0	T	8.9	1.6	5.9	19.8	T	0.0	0.0	36.2
1964-65	0.0	0.0	0.0	0.0	2.3	11.1	11.7	11.5	24.7	T	0.0	0.0	61.3
1965-66	0.0	0.0	0.0	T	0.2	6.6	13.5	4.3	0.7	T	1.6	0.0	26.9
1966-67	0.0	0.0	0.0	T	0.5	8.4	25.1	21.5	8.8	3.4	T	0.0	67.7
1967-68	0.0	0.0	T	6.6	2.4	2.9	10.4	3.8	1.5	0.1	0.0	0.0	27.7
1968-69	0.0	0.0	0.0	0.0	0.7	10.9	3.7	2.3	4.7	0.0	T	0.0	22.3
1969-70	0.0	0.0	0.0	0.0	2.0	19.3	9.5	6.3	11.8	7.2	0.0	0.0	56.1
1970-71	0.0	0.0	0.0	0.0	0.2	2.7	10.0	1.4	8.0	0.6	T	0.0	23.1
1971-72	0.0	0.0	0.0	0.0	1.3	0.2	7.6	7.7	16.8	3.3	0.0	0.0	36.9
1972-73	0.0	0.0	0.0	0.1	0.9	11.2	0.5	9.3	3.4	0.2	T	0.0	25.6
1973-74	0.0	0.0	0.0	0.0	T	18.8							

Record mean values above (not adjusted for instrument location changes listed in the Station Location table) are means for the period beginning in 1958.

# Indicates a break in the data sequence during the year, or season, due to a station move or relocation of instruments. See Station Location table.

STATION LOCATION

CHICAGO, ILLINOIS
O'HARE INTERNATIONAL AIRPORT

Location	Occupied from	Occupied to	Airline distance and direction from previous location	Latitude North	Longitude West	Elevation above										Remarks
						Sea level	Ground								Sea level	
						Ground at temperature site	Wind instruments	Extreme thermometers	Psychrometer	Telepsychrometer	Tipping bucket rain gage	Weighing rain gage	8" rain gage	Hygrothermometer	Pyranometer	
International Building	10/30/58	Present		41° 59'	87° 54'	658	b20	41 d39	40 d39			c38 d39	36 d38	a4		a - Commissioned 3300 feet SW of office 12/1/60. b - 65 feet to 12/8/60. c - Commissioned 6/4/61. d - Relocated 1200 feet E 4/12/63

Requests for additional climatic information should be addressed to: Director, National Climatic Center, Federal Building, Asheville, N. C. 28801

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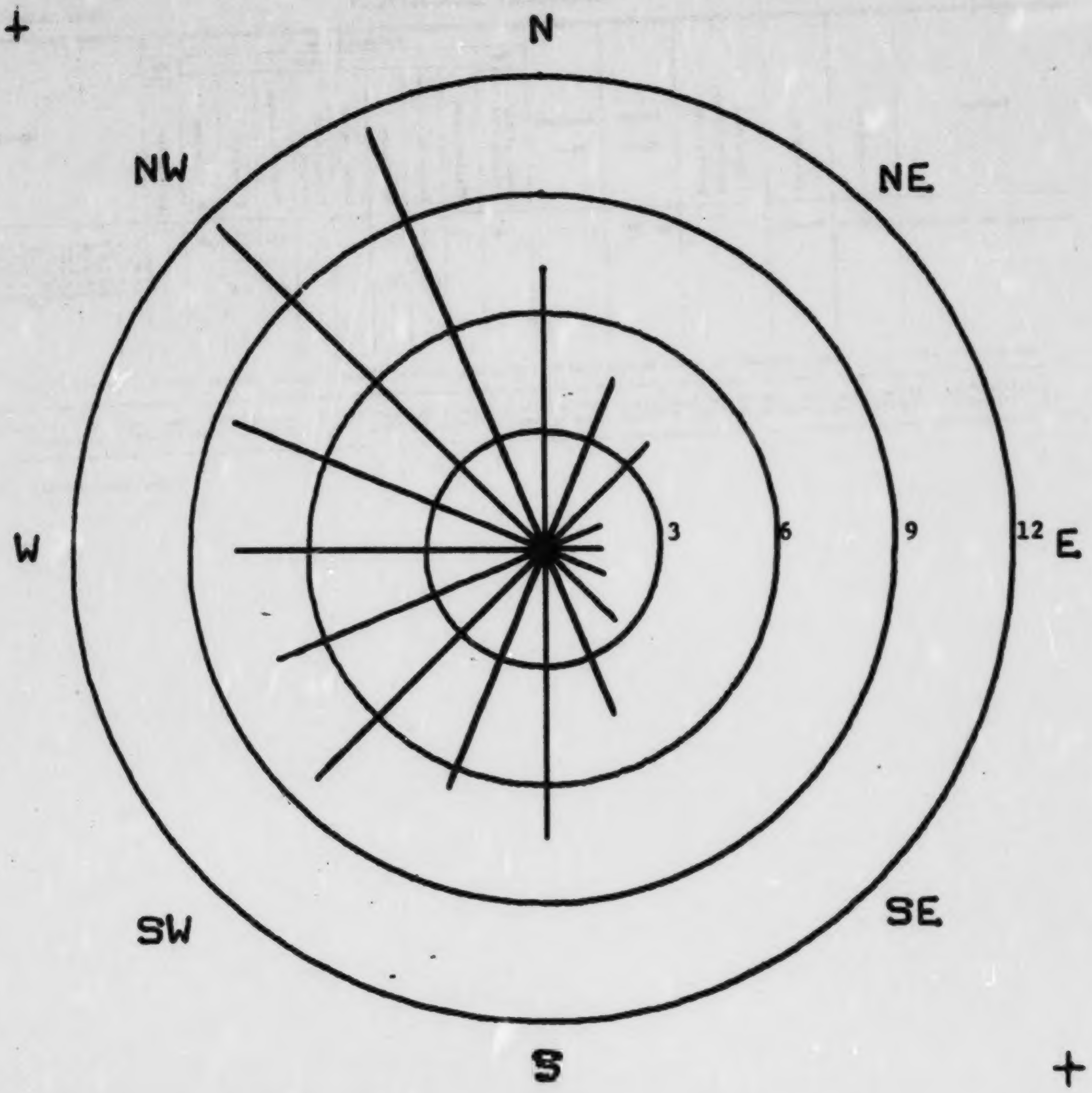
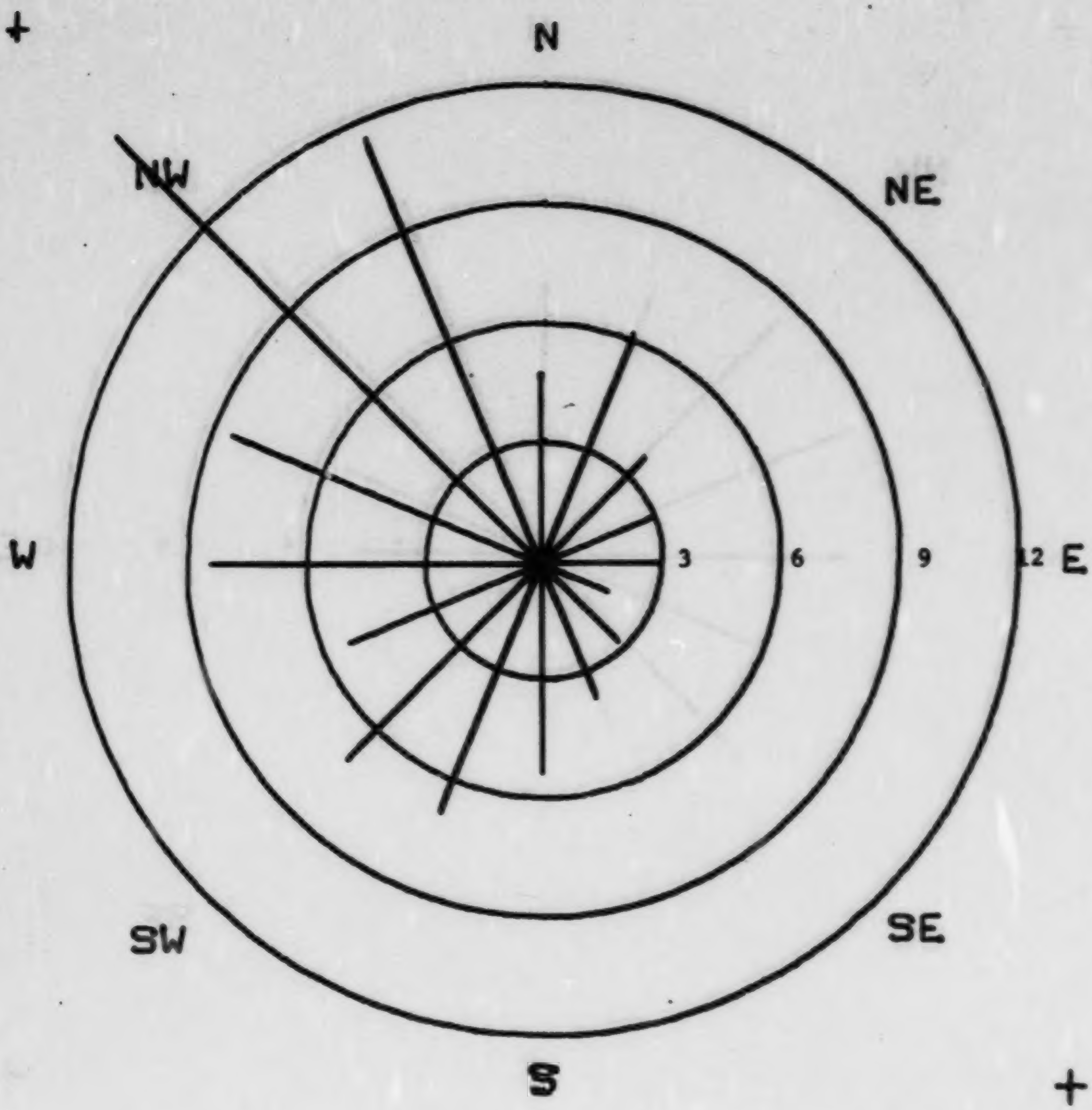


CHICAGO, ILLINOIS
O'HARE
JANUARY
1956-1960

3% Calm

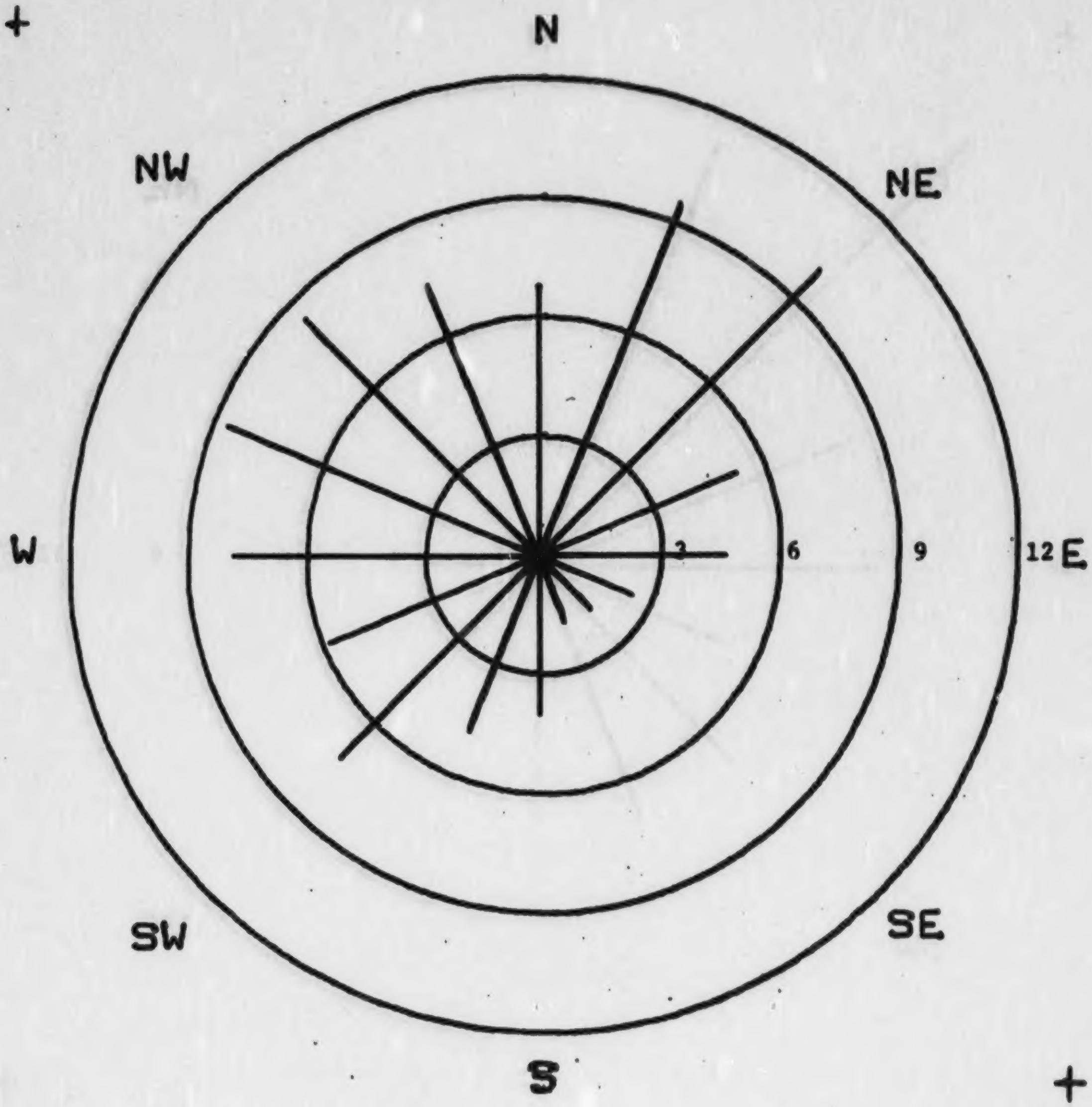
HOURLY WIND ROSE



CHICAGO, ILLINOIS
O'HARE
FEBRUARY
1956-1960

2.3% Calm

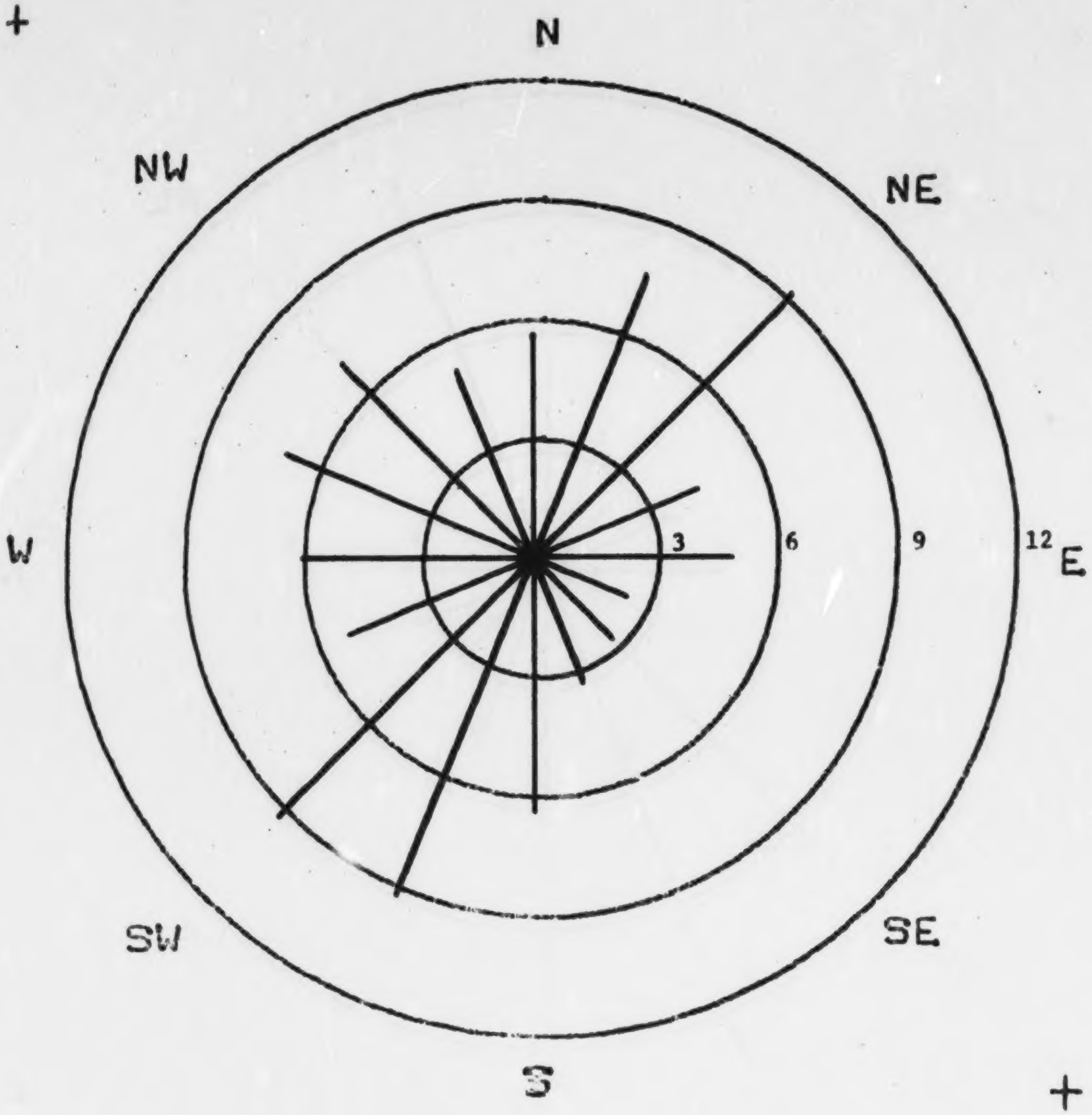
HOURLY WIND ROSE



CHICAGO, ILLINOIS
O'HARE
MARCH
1956-1960

2.8% Calm

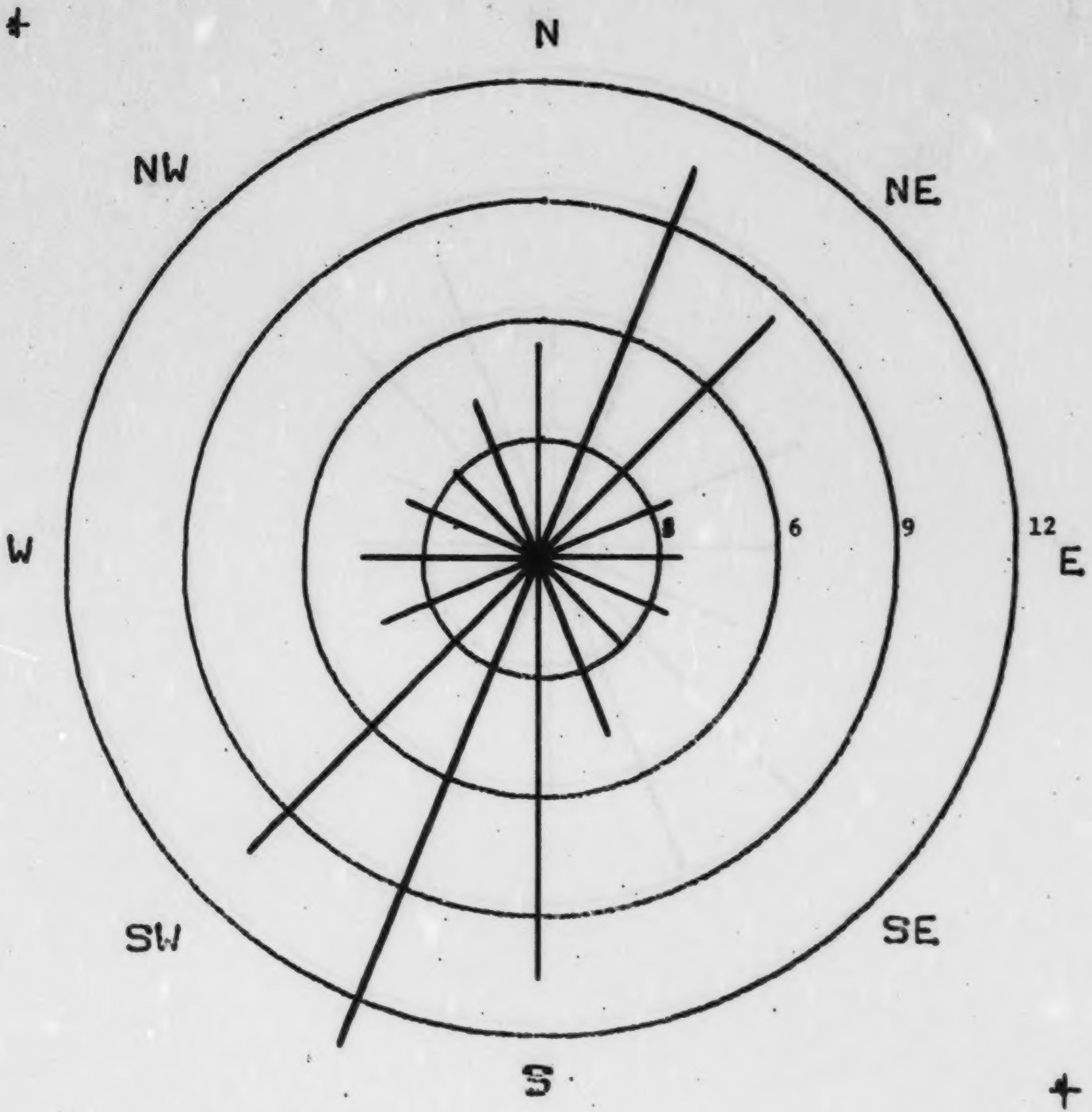
HOURLY WIND ROSE



CHICAGO, ILLINOIS
O'HARE
APRIL
1956-1960

3.8% Calm

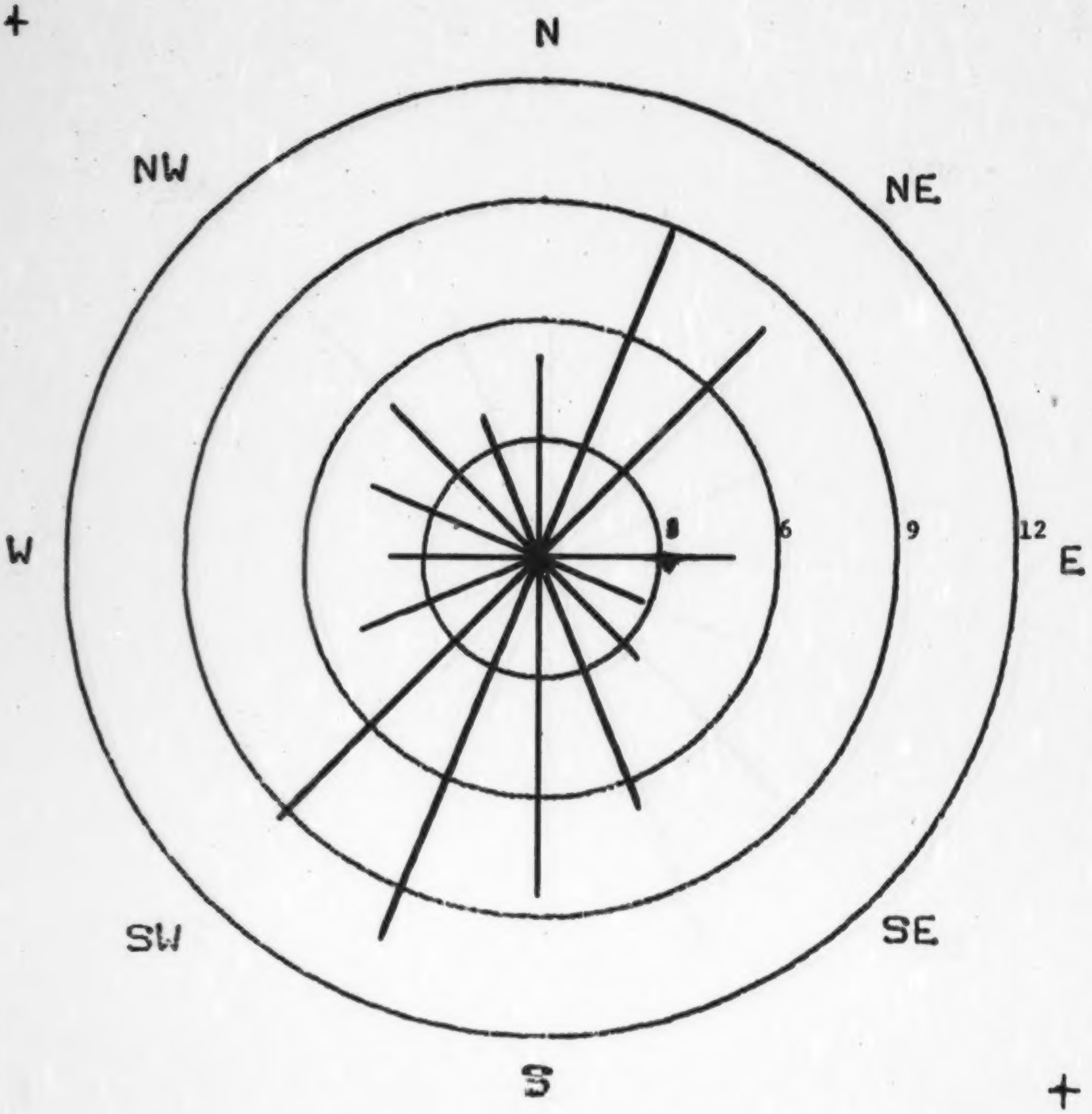
HOURLY WIND ROSE



CHICAGO, ILLINOIS
O'HARE
MAY
1956-1960

3.0% Calm

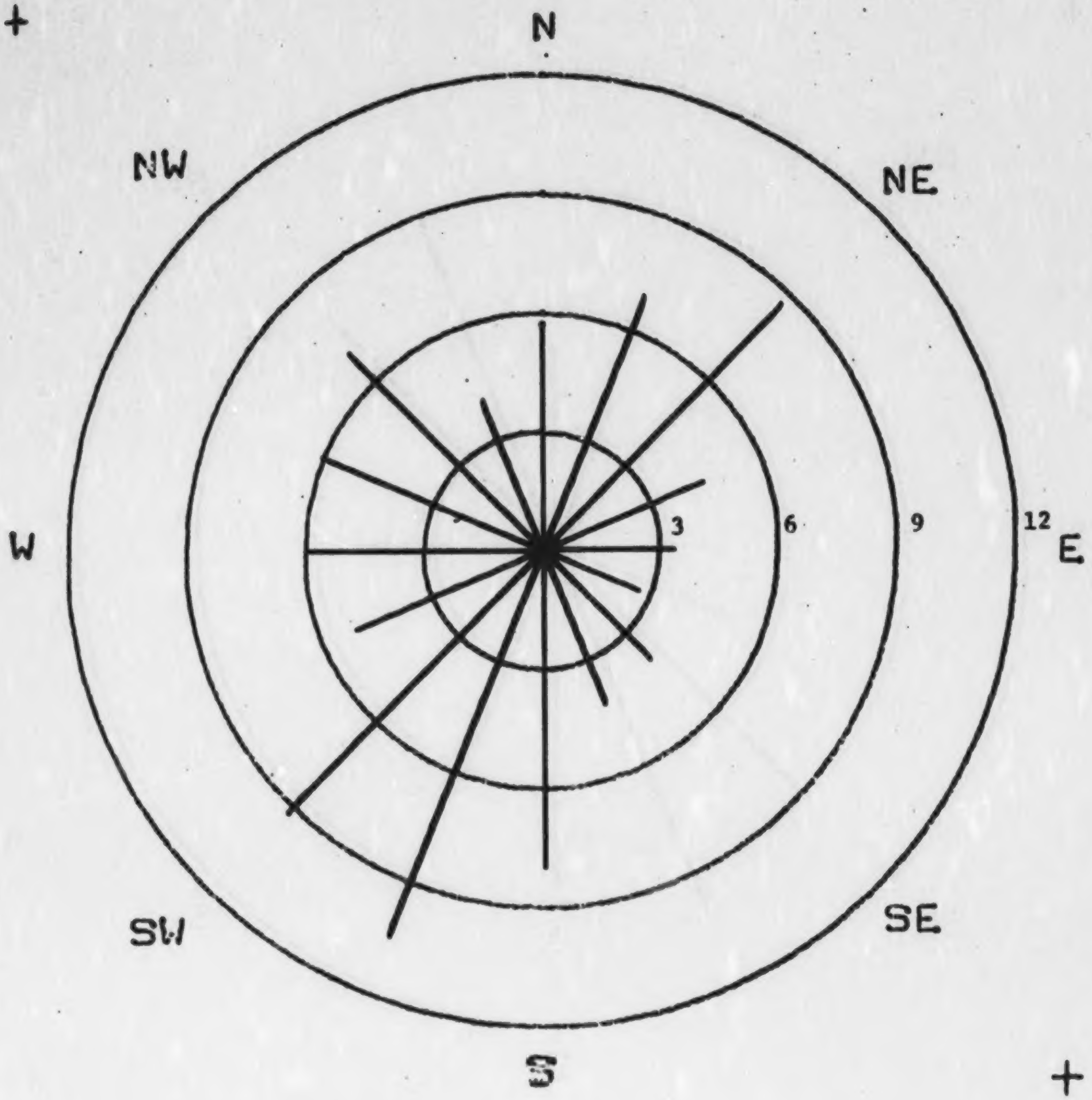
HOURLY WIND ROSE



CHICAGO, ILLINOIS
O'HARE
JUNE
1956-1960

4.1% Calm

HOURLY WIND ROSE

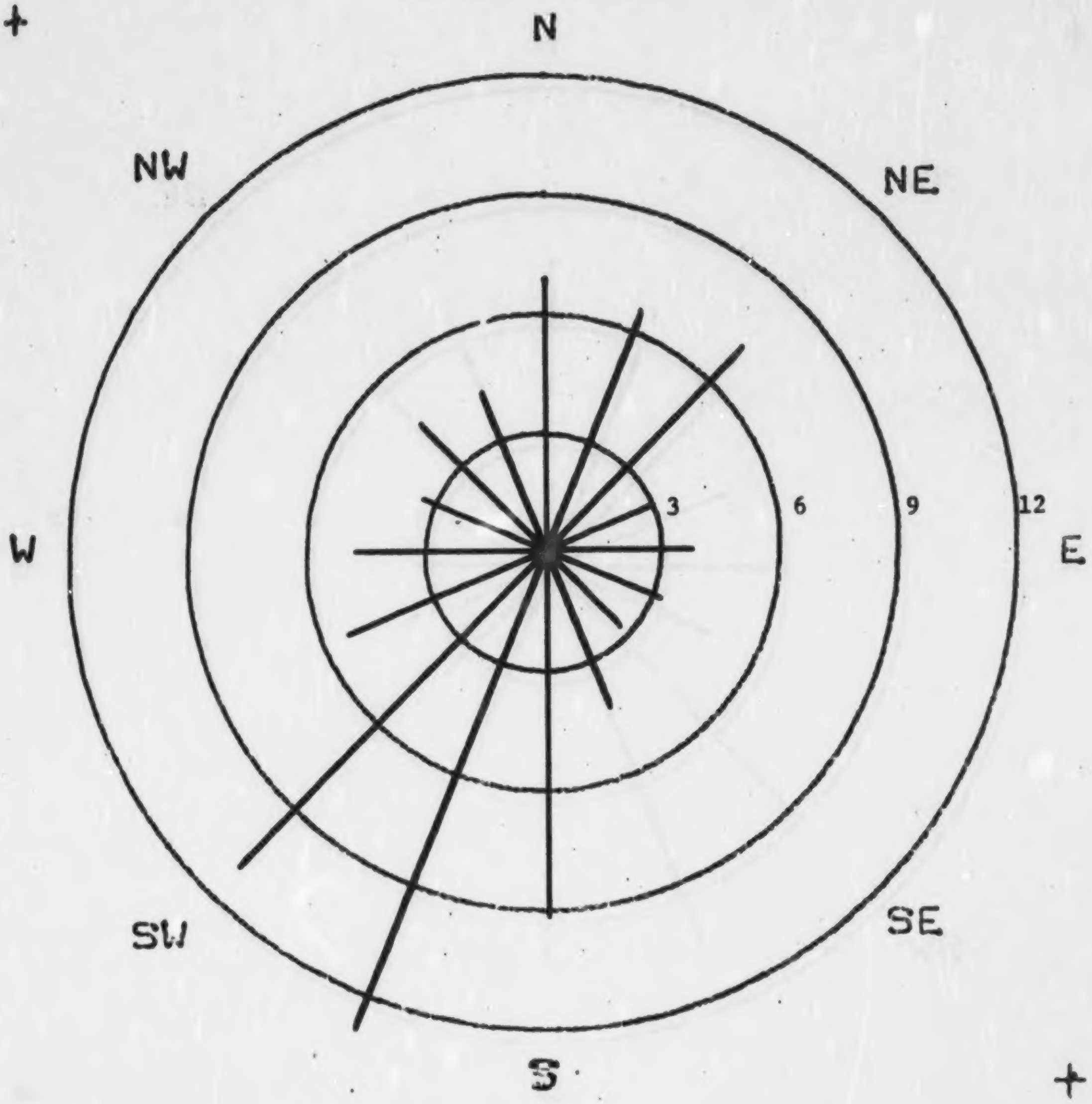


CHICAGO, ILLINOIS
O'HARE
JULY

1956-1960

3.9% Calm

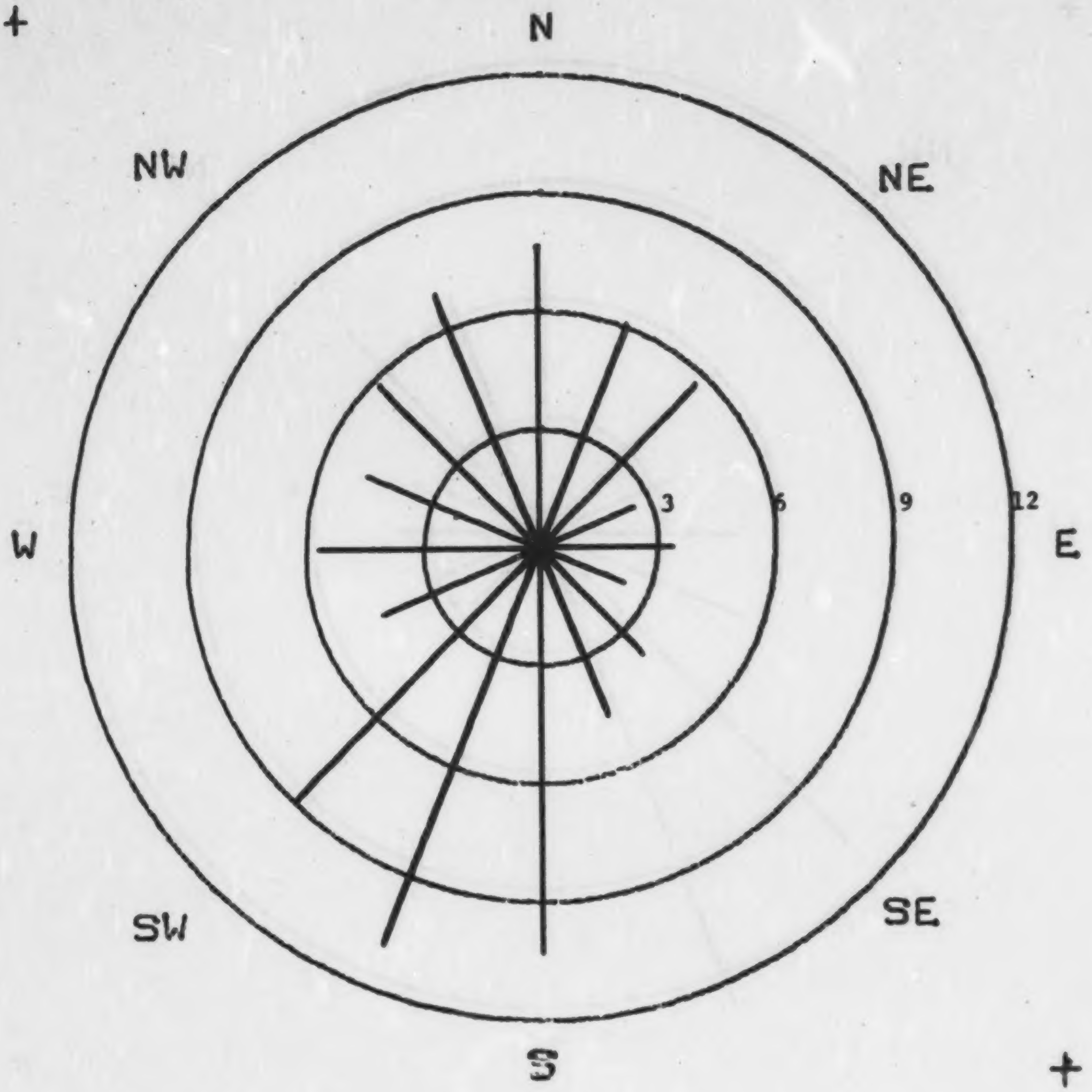
HOURLY WIND ROSE



CHICAGO, ILLINOIS
O'HARE
AUGUST
1956-1960

6.5% Calm

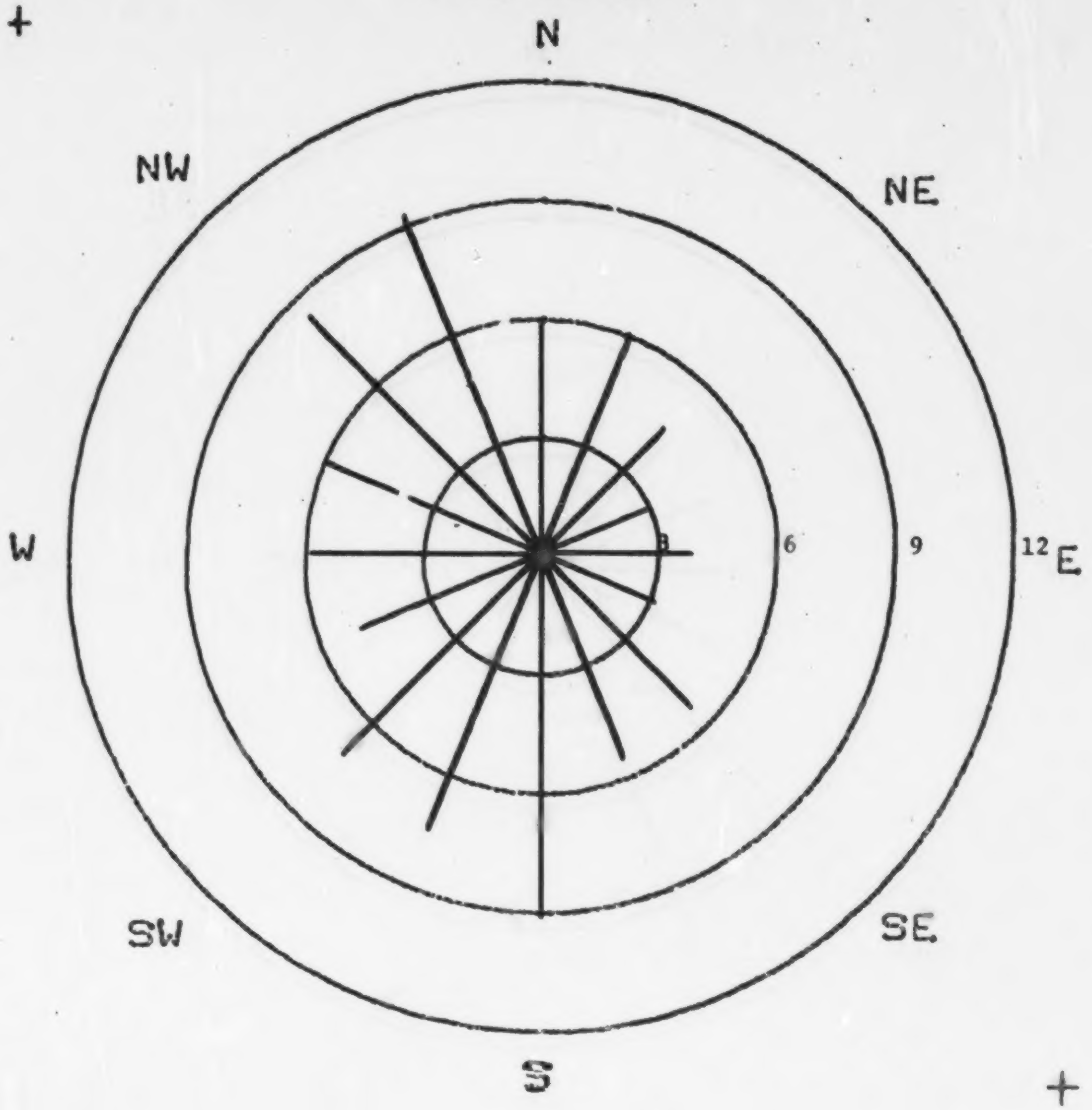
HOURLY WIND ROSE



CHICAGO, ILLINOIS
O'HARE
SEPTEMBER
1956-1960

6.0% Calm

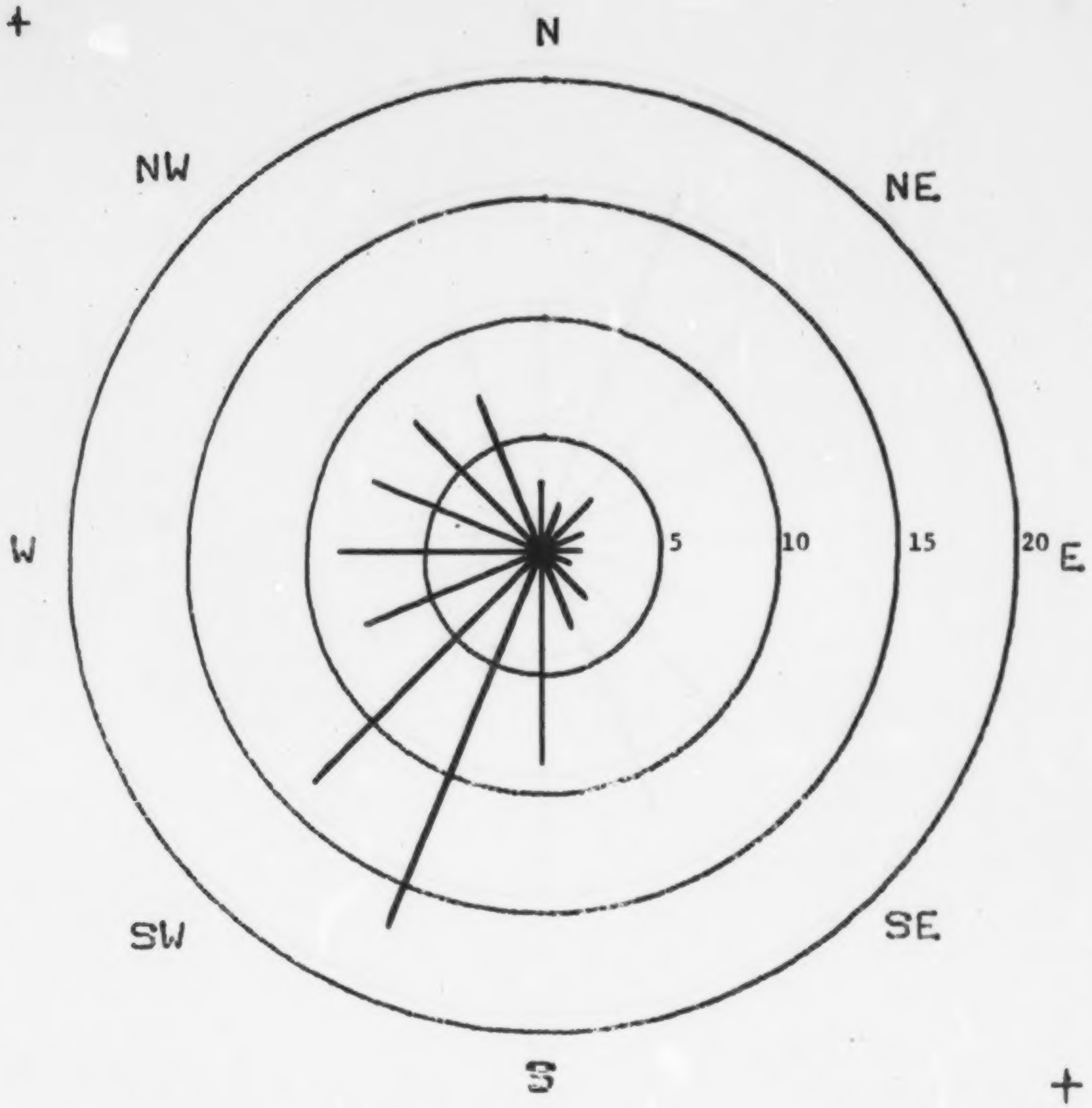
HOURLY WIND ROSE



CHICAGO, ILLINOIS
O'HARE
OCTOBER
1956-1960

3.7% Calm

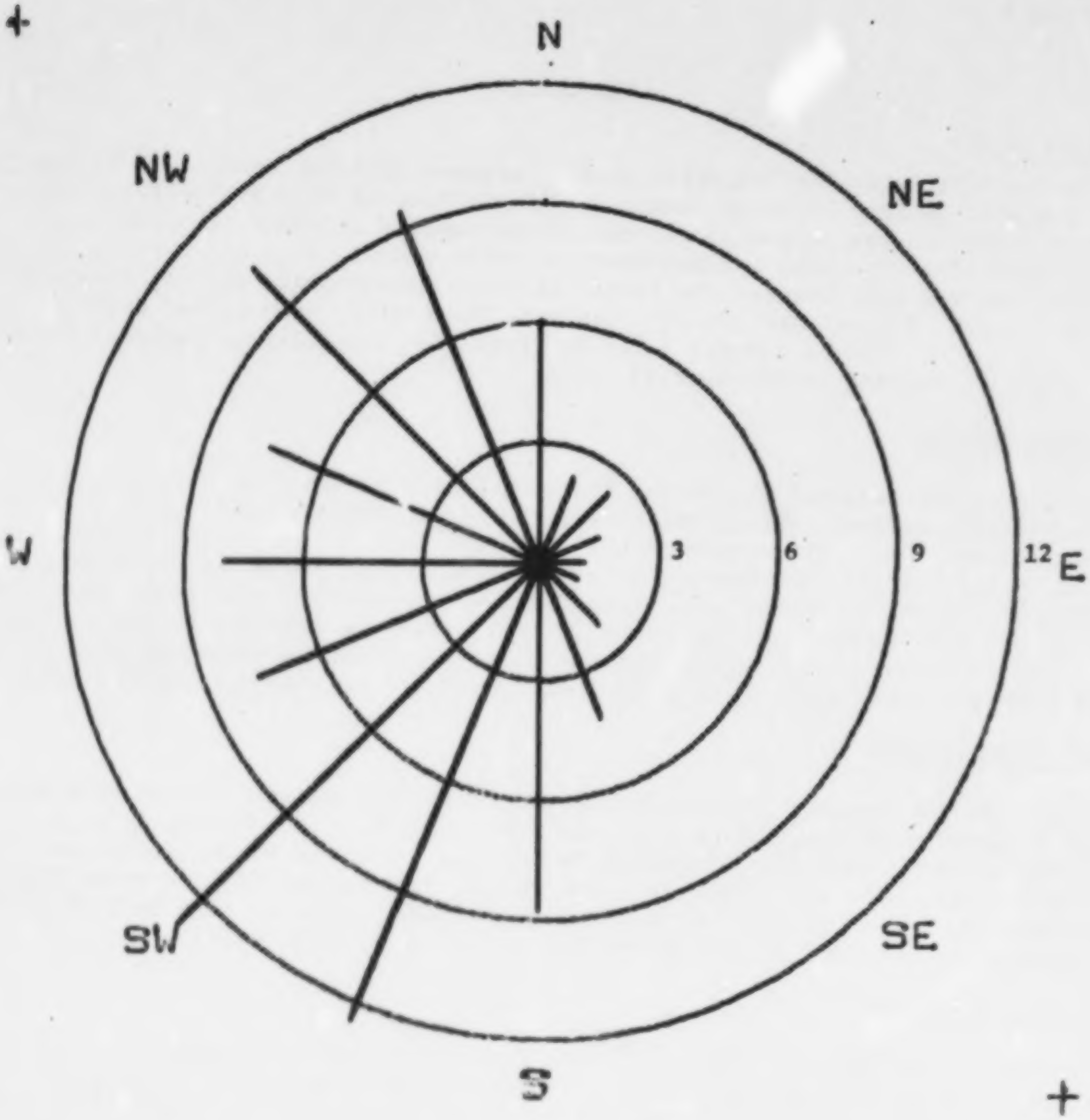
HOURLY WIND ROSE



CHICAGO, ILLINOIS
O'HARE
NOVEMBER
1956-1960

2.0% Calm

HOURLY WIND ROSE



CHICAGO, ILLINOIS
O'HARE
DECEMBER
1956-1960

1.9% Calm

ENCLOSURE B

AIR QUALITY

The "Airport Vicinity Air Pollution Study," Argonne National Laboratories, Energy and Environmental Systems Division, Argonne Illinois Federal Project FA-71WI-223, initiated in 1971, surveyed the following air quality parameters at O'Hare International Airport: carbon monoxide, CO; total hydrocarbons; nitrogen oxides, NO_x; and particulate matter. A comparison was made between the levels of these constituents and the levels specified in the National Ambient Air Quality Standards (40 CFR50), promulgated pursuant to the Clear Air Act of 1967 as amended in 1970. Following are selected excerpts presented at the public hearing on December 19, 1974.

NITROGEN OXIDES:

According to the National Standards, the annual average level of nitrogen oxides, as photochemical oxidants, should not exceed 160 micrograms per cubic meter or 0.08 p.p.m. maximum in one hour. The Argonne Study, however, indicates nitrogen oxides, average levels as high as 209 micrograms per cubic meter or 0.10 p.p.m. at the O'Hare perimeter (p.14), at the end of Runway 14L, about 2 miles from the proposed plant site levels as high as 440 micrograms per cubic meter or 0.21 p.p.m. (p.181) and at the old Ravenswood Airport less than 1/4 miles from the plant site concentrations as high as 320 micrograms per cubic meter or 0.155 p.p.m. (p. 81 and converted to 32°F., p.278).

TOTAL HYDROCARBONS:

According to the National Standards the maximum concentrations for a 3 hour period, not to be exceeded more than once a year, is 160 micrograms per cubic meter or 0.24 p.p.m. The Argonne Study, however, indicates average levels at the O'Hare perimeter of 1970 micrograms per cubic meter or 2.75 p.p.m. (p.14) and at the old Ravenswood Airport area approximately 1/4 miles from the proposed plant site levels as high as 2130 micrograms per cubic meter or 2.97 p.p.m. (p. 81 and converted to 32°F.,p.278).

PARTICULATE MATTER:

According to the National Standards, the secondary standards provide that the annual average of particulate matter should not exceed 60 micrograms per cubic meter and the primary standards provide an annual average of 75 micrograms per cubic meter and a 24 hour maximum not to exceed 260 micrograms per cubic meter. The Argonne Study, however, indicates levels outside O'Hare as high as 180 micrograms per cubic meter and inside O'Hare as high as 240 micrograms per cubic meter (p.189). Also significant in this regard is the statement on page 187 of the Argonne Study in reference to certain areas inside O'Hare as follows:

> "If such levels persist throughout the year, then the annual standard of 75 micrograms per cubic meter would certainly be exceeded."...

With regard to the level of all pollutants reported in the Study, the Argonne personnel observe on p.82, that the level of pollutants obviously increases in the immediate area of the jet engine exhaust plume and further on p. 174 that such exhaust plume trailing a landing aircraft is visible at ground level for a distance of 1 to 2 miles from the end of the runway. Thus aircraft landing on runway 14L will leave a jet engine exhaust plume with high pollution levels extending from 1 to 2 miles from the end of runway 14L and therefore directly into and onto the area of the plant site....

One might assume or hope that the ambient air quality may have improved since 1972 through the employment and adoption of the so called "smokeless" jet engine employing retro-fitted clean burners or through reduced aircraft operations. Unfortunately this is not the situation. For example, on p.215 of the Argonne Study, an analysis of the Pratt and Whitney JT8D engine, used for such aircraft as the B-727, the DC-9 and the B-737 is provided showing a comparison before and after retro-fitting. Such analysis reveals that the hydrocarbon emissions for the clean burning engine when compared to the unmodified engine is approximately the same during both take-off and landing. However, such analysis, does show an increase in the level of nitrogen oxides for the clean burning engine during both take-off and landing. These nitrogen oxides are, of course, a main reactant in the photochemical production of smog, which is universally recognized as a serious health hazard.

Moreover, there has not been any reduction in flight operations since 1972 but rather an increase in the number of flights. Thus the level of pollutants in the plant site area has probably risen since 1972 and will rise even further in the future with an increase in the number of flights at O'Hare.

According to a report prepared by the Northeastern Illinois Planning Commission entitled "Metropolitan Aircraft Noise Abatement Policy Study, O'Hare International Airport, Chicago, Illinois" dated July 1971, the number of aircraft operations has steadily increased over the years and in 1975 there should be in excess of 700,000 flight operations. This Report which is also cited by the District in their assessment further reveals that runway 32R in 1965 was employed approximately 44 percent of the time for take-offs and predicts that in 1975 such runway will be employed approximately 73.88 percent of the time for take-offs. This runway is, of course, the nearest to the plant site and in fact directs aircraft directly over the site. These increased operations for such runway, with associated high levels of pollutants such as nitrogen oxides, will directly and adversely affect the quality of air at the proposed plant site.

ENCLOSURE C

THE ESTIMATED RAW WASTEWATER INFLUENT TO THE O'HARE WATER RECLAMATION PLANT IS AS FOLLOWS:

PROCESS CONDITIONS (a)

	INFLUENT CONCENTRATIONS:	PROPOSED EFFLUENT CONCENTRATIONS:
F (MGD)	72	72
PO (mg/1)	5-15	4.0
BOD_5 (mg/1)	146	4.0
DO (mg/1)	0	5.0
SS (mg/1)	180	5.0
RC (mg/1)	0	1.0
NH_3-N (mg/1)	20	2.5

(a)= ALL CONDITIONS APPROXIMATE AND SUBJECT TO CONFIRMATION BY CONSULTANT.

THERE ARE NO UNUSAL INDUSTRIAL WASTE LOADINGS ANTICIPATED IN THE SERVICE AREA. FLOW PROJECTIONS ARE AS INDICATED:

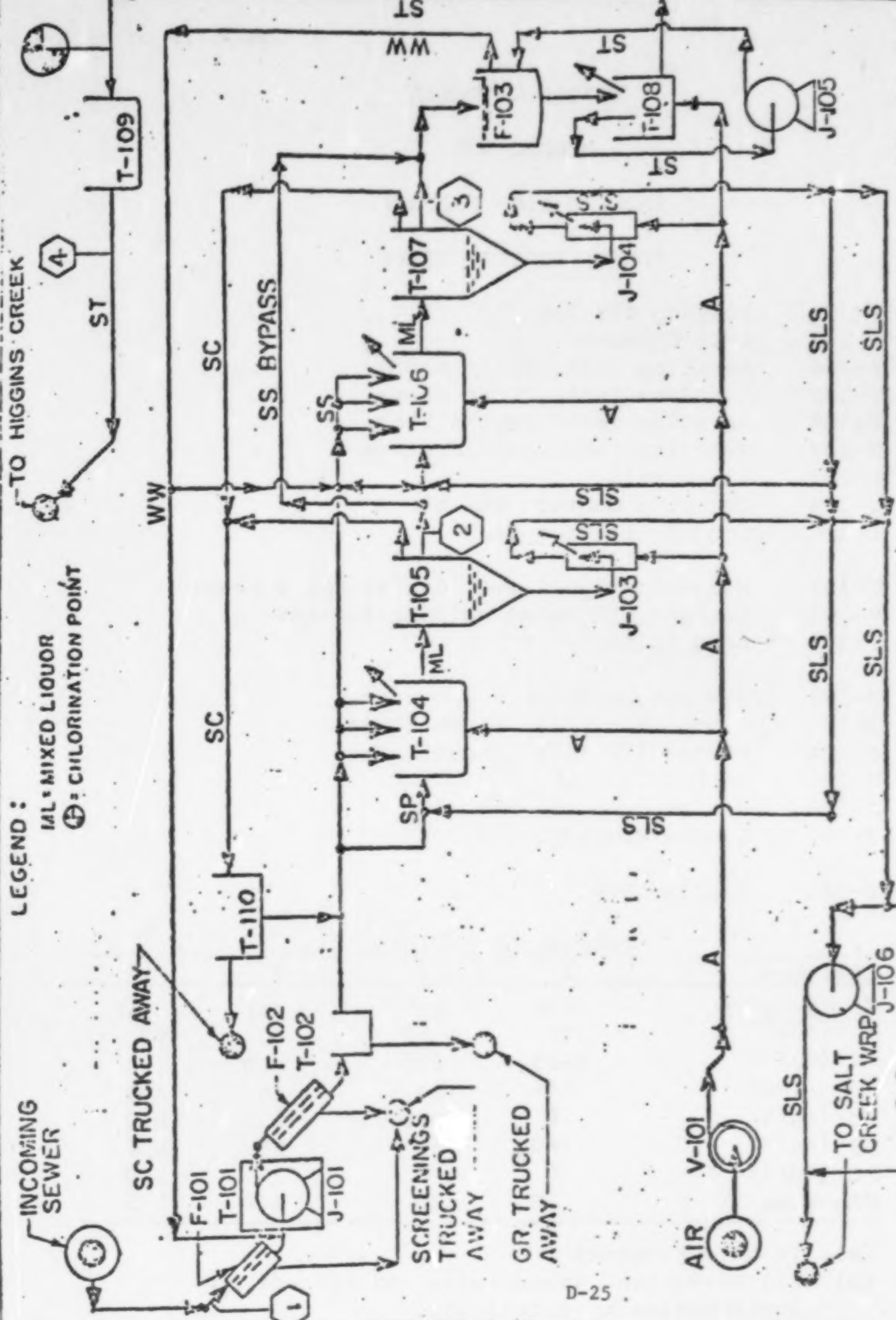
GALLONS PER CAPITA PER DAY:

YEAR:	POP.(1000):	DOMESTIC:	INDUSTRIAL:	INFILTRATION ALLOW.	EXC.:	TOTAL:	FLOW (MGD):
1970	223(1)	73	29	33	15	150	30
1980	261	80	61	33	0	174	45
1990	277	94	75	33	0	202	56
2000	300	113	78	32	0	223	67
2010	315	116	74	32	0	222	70
2020	332	117	70	32	0	219	73
2030	350	118	67	31	0	216	75

(1)= SEWERED POPULATION IN 1970 = 200,700

TOTAL PROJECTED FLOWS:

NIPC POP.:	DOMESTIC FLOW (GPCPD):	INDUSTRIAL FLOW (MGD):	TOTAL FLOW (MGD):
1970 - 223,000	106	6.4	30.0
1980 - 261,000	113	16.0	45.5
1990 - 277,000	127	20.8	56.0
2000 - 300,000	144	23.4	66.6
2010 - 315,000	148	23.4	70.0
2020 - 332,000	149	23.4	72.9
2030 - 350,000	150	23.4	75.9


LEGEND:
ML: MIXED LIQUOR
⊕: CHLORINATION POINT
INCOMING SEWER
F-101
T-101
J-101
F-102
T-102
SC TRUCKED AWAY
SCREENINGS TRUCKED AWAY
GR. TRUCKED AWAY
T-110
T-109
TO HIGGINS CREEK
ST
WW
SC
SS BYPASS
SS
SP
T-104
ML
T-105
J-103
T-106
T-107
J-104
F-103
T-108
J-105
A
SLS
AIR
V-101
TO SALT CREEK WRP
J-106
J-107
1
2
3
4

O'HARE WATER RECL·AMATION PLAN
PROCESS FLOW DIAGRAM
CONT ACT 67-300-2P

Flowsheet intended to be descriptive.
[illegible] responsibility of consultant.

DESIGN CRITERIA

O'HARE WRP

PROCESS FLOW DIAGRAM

IDENTIFICATION SHEET

T-101	Pumping Station
T-102	Grit Chamber
T-104	Aeration Tank, First Stage
T-105	Settling Tank, First Stage
T-106	Aeration Tank, Second Stage
T-107	Settling Tank, Second Stage
T-108	Clear Well
T-109	Chlorine Contact Chamber
T-110	Scum Dewatering Tank
F-101	Mechanically Cleaned Coarse Bar Screens
F-102	Mechanically Cleaned Fine Screens
F-103	Sand Filter
J-101	Raw Sewage Pumps
J-103	Sludge Air Lift, First Stage
J-104	Sludge Air Lift, Second Stage
J-105	Back Wash Pump
J-106	Sludge Transfer Pump #1
J-107	Sludge Transfer Pump #2
V-101	Air Blowers

PROCESS CONDITIONS (b)

Position	1	2	3	4
P (Ft H_2O)	(a)	(a)	(a)	(a)
F (MGD)	72	72	72	72
PO (mg/l)	5-15	4.0	4.0	4.0
BOD_5 (mg/l)	146	20	15	4.0
DO (mg/l)	0	2.0	2.0	5.0
SS (mg/l)	180	25	25	5.0
RC (mg/l)	0	0	0	1.0
NH_3-N (mg/l)	20	20	2.5	2.5

(a) To be determined

(b) All conditions approximate and subject to confirmation by consultant.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
National Environmental Research Center
Research Triangle Park, North Carolina 27711

January 23, 1975

ENVIRONMENTAL PROTECTION AGENCY
RECEIVED
JAN 28 1975
PLANNING BRANCH - Region V
FILE NO.

Mr. Harlan D. Hirt
Chief, Planning Branch
Environmental Protection Agency, Region V
230 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. Hirt:

As you requested, I have answered the Questionnaire relating to the O'Hare Water Reclamation Plant. I have limited myself to answering the questions related to health effects which is my area of expertise. As you will see, the state of knowledge of the potential health significance of aerosols formed during the treatment process is practically non-existent. I am attaching a list of the few references on this subject which we have been able to find.

Sincerely yours,

Edythalena Tompkins
Epidemiology Branch
Human Studies Laboratory

Attachments

Reply to Questionnaire

1. Before synergistic effects resulting from exposure to two or more agents can be demonstrated, it is necessary to identify and quantify the effects associated with the individual agents. At the present time, neither effects which might be associated with airplane emissions nor aerosols or gases from wastewater treatment processes have been identified nor quantified.

2. The only published epidemiologic study of which I am aware which investigated health hazards associated with wastewater treatment evaluated reported illness episodes in sewage treatment plant workers. Rather than interpret the findings, I will give you the reference:

> Ledbetter, Hanek, Reynolds, "Health Hazards from Wastewater Treatment Practices," Environmental Letters 4:225 (1973)

EPA is currently conducting epidemiology investigations of a population living in the environs of a wastewater treatment facility and of wastewater treatment plant workers.

3. There is not sufficient data available to have a valid opinion about the potential health hazard of locating this or any other plant in a populated area. One can make an educated guess that the health risks associated with the operation of wastewater treatment plants must be relatively small or there would not be such a paucity of information on the subject. There are many plants operating in populated areas throughout the world and it can be assumed that any "significant" disease outbreak associated with such plants would have been reported.

4. I have no opinion on this subject.

5. Without any knowledge of the potential health hazard, it is impossible to recommend protective measures.

6. I have no opinion on this subject.

7. This question is not clear. If you are asking whether I am aware of any other wastewater treatment plants which have been opposed on the basis of potential health hazards, the answer is the North Shore Plant in Chicago, and I am sure you know what the issues were and how they were resolved.

References

Emission of Microbial Aerosols from Sewage Treatment Plants that Use Trickling Filters, Goff, Spendlove, Adams and Nichols

Health Services Reports, August-September 1973, Vol. 88, No. 7, pp. 640-652.

Sizes and Numbers of Aerosols Generated by Activated Sludge Aeration, Glaser and Ledbetter

Water and Sewage Works, June 1967, pp. 219-221

Microbial Content of Air Near Sewage Treatment Plants, Napolitans and Rowe

Water and Sewage Works, December 1966, pp. 480-483

Coliform Aerosols Emitted by Sewage Treatment Plants, Adams and Spendlove

Science, September 1970, pp. 1218-1220

Bacteria Air Pollution from Activated Sludge Units, Randall and Ledbetter

American Industrial Hygiene Association Journal, November-December 1966, pp. 506-519

Hutton D. Slade, Ph.D.
Consultant in Microbiology
303 East Chicago Avenue
Chicago, Illinois 60611

ENVIRONMENTAL PROTECTION AGENCY
RECEIVED
JAN [illegible]
PLANNING BRANCH - Region V
FILE NO.__________

29 January 1975

Mr. Harlan D. Hirt
Chief, Planning Branch
U.S. Environmental Protection Agency
230 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. Hirt,

In response to your letter of 16 January 1975 concerning the O'Hare Water Reclamation Plant, I can reply to the following questions which you presented.

1. Question: In your opinion, is there any significant health hazard associated with sitting a wastewater treatment plant of this size and process type in this location? Why?

Reply: There is a potential health hazard associated with the O'Hare plant. This hazard concerns the possible spread of bacterial and viral respiratory pathogens which would be emitted into the air above the aeration tanks in aerosol droplets. The information available in the scientific literature concerning the aerosol spread of bacteria and viruses is summarized in my "Report to the Mayor and City Council of the City of Des Plaines Concerning Ordinance M-23-74", dated 15 November 1974. In my opinion the evidence indicates that a health hazard exist in the case of the O'Hare plant. The 6.6 acres of aeration tanks would provide constant source of aerosol clouds. The changing pattern of wind direction at various times of the year would assure the movement of these clouds in all directions. The bacterial and viral content per unit volume of cloud and the size of the clouds would increase as the acreage of the aeration tanks reached its capacity of 8.6 acres. Those Des Plaines homes located within 400 feet of the north side of the aeration tanks would be especially vulnerable to these aerosol clouds. As stated in my report, the evidence indicates that viable bacterial and viruses can travel much further than this distance.

2. Question: Is there a minimum distance and/or special protective measures which should be incorporated into the design of a treatment plant such as this to protect the workers and the adjacent residential communities from any potential health hazard?

Reply: In order to prevent the dissemination of aerosol clouds the aeration tanks would need to be covered. The air which would be emitted from these covered tanks would need to be passed through filters and then burned. This combined process would guarantee that the viable bacterial and viral content of this air was zero.

I would appreciate receiving a copy of your environmental impact statement.

Sincerely yours,

Hutton D Slade

Hutton D. Slade, Ph.D.
Consultant in Microbiology

HDS/pb

NORTHWESTERN UNIVERSITY
EVANSTON, ILLINOIS 60201

THE TECHNOLOGICAL INSTITUTE
DEPARTMENT OF CIVIL ENGINEERING

January 30, 1975

ENVIRONMENTAL PROTECTION AGENCY
RECEIVED
JAN 31 1975
PLANNING BRANCH - Region V
FILE NO.

Mr. Harlan D. Hirt
Chief, Planning Branch
U.S. Environmental Protection Agency
Region V
230 South Dearborn Street
Chicago, Illinois 60604

Re: O'Hare Water Reclamation Plant
Questionnaire

Dear Mr. Hirt:

Thank you for sending the material dealing with the description of the propsed O'Hare Water Reclamation Plant in Des Plaines, Illinois and the questionnaire to me for comment. As discussed with Mr. Dale Leucht on the phone, I would be able to comment on only one or two of the seven questions on the questionnaire.

1. The synergistic effect of sulfur dioxide and particulates is well known. The episode air quality standards recognizes this and considers the combination of these pollutants. Specific synergistic effect between airplane related emissions and potential aerosols generated by the activated sludge process has not been documented to my knowledge.

3. The siting of a wastewater treatment plant of 72 to 96 MGD capacity poses the same potential health hazard as with the siting of any wastewater treatment plant handling sanitary wastes. While there is a potential health hazard, the actual manifestation of this hazard has not been documented to my knowledge.

4. Odor problems are frequently associated with the operation of wastewater treatment facilities. The frequency and intensity of the odor problems is highly variable, depending upon the quantity of the operation. Major sources of odors are incoming sewage which may be septic; the bar screen areas; the scum collection areas; and sewage handling and dewatering facilities. Facilities for treatment and dewatering are not planned for the proposed plant. Hence, the major sources of odors is not present. The track record of the MSD in the operation of the North Side Sewage Treatment Plant would be fairly indicative of the odor problems which may be expected in the proposed Des Plaines site. Mild odor problems may pervade a distance of perhaps one-quarter to one-half mile; while, severe problems may pervade a distance of a mile or so. It is my perception that odor problems are infrequent and mild at the North Side Plant.

The trucking and screening of scum from the site may pose a transient odor problem if part of the truck route is along residential streets.

6. Description of the project indicates that sodium hypochlorite will be used for disinfection rather than gaseous chlorine. Hence, the potential release of gaseous chlorine into the air is not present in this situation.

7. The Clavey Road Sewage Treatment Plant in Highland Park is adjacent to residential areas. Covering of all treatment processes and installation of an air cleaning process to treat the process air was installed as a means of providing protection against odor problems. The effectiveness of the system installed can only be ascertained with operational experience. Since the plan is just being completed at present, this experience will not be available for years to come.

Covering of odorous operations without the treatment of the air does serve to confine the odor problem and reduce its impact on the surrounding areas. Aerobic processes are not expected to produce odor problems during normal operations.

Thank you for the opportunity to comment.

Sincerely yours,

J E Quon

J. E. Quon
Professor of Civil Engineering

JEQ/ms

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NATIONAL ENVIRONMENTAL RESEARCH CENTER
CINCINNATI, OHIO 45268

SUBJECT: O'Hare Water Reclamation Plant Questionnaire DATE: Feb. 4, 1975

FROM: Robert L. Bunch, Chief
Treatment Process Development Branch, AWTRL

TO: Mr. Harlan D. Hirt
Chief, Planning Branch
EPA, Region V

Your questionnaire was sent to both Mr. Convery and me. We have combined our reply.

Being a research laboratory, we have had limited field experience, so our reply is based mainly on information in the scientific literature. A list of relevant references is attached.

Enclosure

ENVIRONMENTAL PROTECTION AGENCY
RECEIVED
[illegible]
PLANNING BRANCH - Region V
FILE NO.________________

REPLY TO QUESTIONNAIRE

1. No reactions between airplane emissions and gases from activated sludge treatment processes have been called to our attention. This is not to say that chlorine, if accidentally released, would not react.

2. Dixon and McCabe (4) concluded from the information available that even though operating personnel might be exposed to potentially dangerous materials and organisms in raw sewage, the actual incidence of infections and parasitic diseases acquired from their work is probably not very high. The few cases of infectious hepatitis reported could be chance occurrences. They pointed out that most of the data available from plants dealt mostly with accidents and physical injuries.

   Browning and Gannon (3) reported on a survey by the California State Department of Public Health of health and safety conditions affecting operators at 200 wastewater treatment plants in northern California. Of the 572 operators employed at the plants studied, only one possible job-related infection was reported during the 12-month period preceding the survey. They also found that at more than half of the plants, operators do not receive regular typhoid and tetanus innoculations.

   Ledbetter, et al. (7) made an epidemiological survey of the pneumonia incidence among employees at the major wastewater treatment plants in Texas. The control group was made up of employees of the water treatment plants in many of the same cities as the wastewater plants. The definite cases of pneumonia during employment showed three and six for the wastewater and water plants, respectively. Apparently even though, theoretically, there should be more pneumonia cases from working at a wastewater treatment plant, the data does not indicate it.

   Vireraghavan (11) made a survey of several Ottawa municipalities to determine what diseases were contracted by workers and could be directly correlated with their working environment. On a general analysis, it was found that out of 19 municipalities, 15 reported no illness attributable to the eight diseases that are usually associated with sewage. The few cases of infectious hepatitis can not be related because the incidence of infectious hepatitis among the general population was not available.

3. The literature is replete in documenting the potential hazards of aerosolized sewage organisms. Some of the pertinent references are attached. Although the investigators differ somewhat, it appears that at least 50% of the particles emitted are less than 5.0 microns in diameter. The nasal passages are about 100% efficient in removing or retaining particles five microns or greater. Particles smaller than five microns can penetrate the lungs; therefore, they are considered a potential danger.

Although the potential health hazards exist, the actual data available would indicate that the risk is very small. More than the presence of the pathogens in sewage is needed to cause disease. An infective dose of the organism must be ingested by a person. Apparently this does not happen in the vicinity of a treatment plant. The risk appears minimum.

4. Any poorly run wastewater treatment plant has odors. Methyl mercaptans, methyl sulfide, indoles, skatoles and hydrogen sulfide are common offenders. The most important single aspect of odor control is good housekeeping, preventing deposits of grit, grease and scum. Primary settling basins may need covers if the sewers coming into the plant are septic or contain volatile offensive organic compounds.

5. There is no accepted, rule-of-thumb. It is assumed that scientifically placed wind baffles would prevent the drift of bacteria from the aeration tanks. To our knowledge, this has not been tried. The baffles would be to prevent the drift to the adjacent residential community and not to cut down on the exposure to workers.

6. Hydrogen sulfide emission can occur in plants where the incoming sewage is septic. It is corrosive and has an objectionable odor.

7. No.

AWTRL, Cincinnati

REFERENCES

HEALTH HAZARDS FROM WASTEWATER TREATMENT FACILITIES

1. Adams, A. P., and Spendlove, J. C., "Coliform Aerosols Emitted by Sewage Treatment Plants." Science, 169, 1218 (1970).

2. Benarde, M. A., "Land Disposal and Sewage Effluent: Appraisal of Health Effects of Pathogenic Organisms." Jour. Am. Water Works Assoc., 65, 432 (1973).

3. Browning, G. E., and Gannon, J. J., "Operator Protection in Wastewater Treatment Plants." Jour. Water Poll. Control Fed., 35, 186 (1963).

4. Dixon, F. R., and McCabe, L. J., "Health Aspects of Wastewater Treatment." Jour. Water Poll. Control Fed., 36, 984 (1964).

5. Glaser, J. R., and Ledbetter, J. O., "Sizes and Numbers of Aerosols Generated by Activated Sludge Aeration." Water & Sewage Works, 114, 6, 219 (1967).

6. Goff, G. D., et al., "Emission of Microbial Aerosols from Sewage Treatment Plants That Use Trickling Filters." Health Service Repts., 88, 640 (1973).

7. Ledbetter, J. O., et al., "Health Hazards from Wastewater Treatment Practices." Environmental Letters, 4, 3, 225 (1973).

8. Ledbetter, J. O., "Air Pollution from Aerobic Waste Treatment." Water & Sewage Works, 111, 1, 62 (1964).

9. Napolitano, P. J., and Rowe, D. R., "Microbial Content of Air Near Sewage Treatment Plants." Water & Sewage Works, 113, 480 (1966).

10. Randall, C. W., and Ledbetter, J. O., "Bacterial Air Pollution from Activated Sludge Units." Am. Ind. Hygiene Jour., 27, 506 (1966).

11. Viraraghavan, T., "Occupationally Related Health Hazards in Wastewater Treatment Systems." Water Poll. Control Fed., Highlights, 10, 11, 2 (1973).

AWTRL, Cincinnati

hrs DEPARTMENT OF HEALTH AND REHABILITATIVE SERVICES . . . . STATE OF FLORIDA
Oliver J. Keller, Secretary
Reubin O'D Askew, Governor

DIVISION OF HEALTH

POST OFFICE BOX 210 • JACKSONVILLE, FLORIDA 32201 • PHONE (904) 354-3961
E. Charlton Prather, M.D., M.P.H., Director

PLEASE REPLY TO:
EPIDEMIOLOGY RESEARCH CENTER
4000 WEST BUFFALO AVENUE
TAMPA, FLORIDA 33614
TELEPHONE (813) 876-1351

January 29, 1975

ENVIRONMENTAL PROTECTION AGENCY
RECEIVED

PLANNING BRANCH - Region V
FILE NO.

Harlan D. Hirt
Chief, Planning Branch
U. S. Environmental Protection Agency
Region V
230 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. Hirt:

Attached are my responses to the questions posed in your communication of 16 January. Unfortunately, we have only scratched the surface in approaching the solutions to problems posed. At least a start has been made.

I hope these data will be of help to you.

Respectfully,

Flora Mae Wellings, Sc.D.
Administrator
Epidemiology Research Center

FMW:ms
enc.

ENVIRONMENTAL PROTECTION AGENCY
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FEB 3 1975
PLANNING BRANCH - Region V
FILE NO.

1. Are any synergistic effects known between airplane related emissions and aerosols or gases generated by activated sludge treatment processes? If so, what are these effects?

   Answer: Not qualified to answer.

2. What epidemiological studies have been conducted on the health of sewage treatment plant workers or residents in the area of a treatment facility? What do,the results indicate?

   Answer: To my knowledge there has been only one epidemiological study conducted on the health of sewage treatment plant workers. This was done by Melnick, et al. This has been referred to in several meetings but I do not have the actual reference. I believe it was in the early 1950's. They noted less absenteeism among sewage plant workers than among comparable groups in offices. It was suggested that sewage plant operators are exposed to small quantities of pathogenic organisms over time and, thus, build up immunity. To clarify this issue studies should be done to determine time lost during the first six months of employment. Perhaps we would find the reverse. As for health related effects on residents in the neighborhood of a treatment plant facility, no data are available.

3. In your opinion, is there any significant health hazard associated with siting a wastewater treatment plant of this size and process type in this location? Why or why not?

   Answer: There are numerous references in the literature pertaining to pathogenic organisms in aerosols generated by activated sludge or trickling filter treatment plants. Xing, et al., 1973. Airborne Bacteria from an Activated Sludge Plant. J.E.H., 3650-54; Goff, et al., 1973. Emission of Microbial Aerosols from Sewage Treatment Plants that use Trickling Filters. Health Serv. Rep. 88:640-652; Randall, C. W. and Ledbetter, J. O. Bacterial Air Pollution from Activated Sludge Units. Amer Ind. Hyg. Ass. J. 1966, pp. 506-519. In general these data indicate survival of airborne particles at a distance of three kilometers (1.8 miles) downwind from the source. Emissions and survival of organisms was dependent upon many variables including temperature, relative humidity, wind speed and solar radiation. All plants studied were much smaller (15-30 Mgd) than the proposed plant in Chicago. It has been shown that wind speeds between 6 and 10 miles per hour(MPH) favored emission of microbial aerosols as opposed to wind speeds above or below these levels. Data derived from the Climatography of the United States No. 82-11 furnished with this questionnaire reveals that 47.3% of all observerations made occurred when the wind speed was 5-14 MPH and the relative humidity (RH) between 50 and 89%, a RH which favors survival of polio virus and most probably others in the enterovirus group.

   Another important facet of these studies was the determination that the largest number of particles (7[illegible]) containing viable bacteria were of the size which permits lung penetration (5 microns or less). These data indicate that there is a possible health hazard in siting a waste treatment facility of this size and type in this location.

4. In your opinion, will there be any significant odor problems associated with the operation of a facility such as this? Why or why not?

   Answer: There are odor problems in a half to one mile radius of a 5 MGD activated sludge treatment plant in northwest St. Petersburg. The odors are augumented by humidity and wind direction. I would anticipate that the proposed plant would pose similar problems. However, there are some odor masking chemicals available on the market which has ameliorated, somewhat, the problem in St. Petersburg.

5. Is there a minimum distance and/or special protective measures which should be incorporated into the design of a treatment plant such as this to protect the workers and the adjacent residential communities from any potential health hazard?

   Answer: Since the maximum distances of aerosol spread have not been determined unequivocally, there is little hope of establishing distance standards. However, the use of trees as a barrier would add not only some protection but would have esthetic value as well.

6. In your opinion, would a wastewater reclamation plant of this size and process type produce significant quantities of chemical emissions of a corrosive or abrasive nature? Discuss the reasons why you feel this will or will not be a problem.

   Answer: Not qualified to answer.

7. Are you aware of any other comparable situations where similar issues occurred? What were these issues and how were they resolved?

   Answer: Not really except for #4 as described above.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
NATIONAL ENVIRONMENTAL RESEARCH CENTER
CINCINNATI, OHIO 45268

SUBJECT: Questionnaire about O'Hare Water Reclamation Plant

DATE: February 11, 1975

FROM: Leland J. McCabe
Chief, Criteria Development Branch, WSRL

TO: Harlan D. Hist
Chief, Planning Branch
EPA Region V

FEB 14 1975

During my work assignments with the Public Health Service and the Environmental Protection Agency, I have been asked to consider health effects of human contact with fecies to slightly polluted water and on one occasion to consider the health status of sewage treatment workers. I can answer your questionnaire in light of this experience, but some of your questions would require more specific experience that I do not have.

1. Synergistic effects. I have never considered that there could be synergistic effects but have not given the problem much thought.

2. What epidemiological studies. We were asked by the Safety Committee of the Water Pollution Control Federation to review the health status of sewage treatment plant workers and reported at their annual meeting in Seattle in 1963. From the data we could obtain we concluded that these workers had higher rates of Leptospirosis and Infectious Hepatitis than the general public. Our report suggested some research that would provide more data on this problem. A copy of the paper is attached.

Funds were provided in this fiscal year for some of the research we suggested and a grant from EPA to conduct this research is about to be awarded. Another part of EPA has let a contract to study the effects on nearby residents.

State and local health agencies do investigate the unusual occurrence of disease. To my knowledge, I know of no occasion when an unusual amount of disease in nearby residents of sewage treatment plants required an investigation. This is not very good evidence that there is not a problem but the extent of food and waterborne disease is determined by this technique. A recent publication by the Center for Disease Control - Foodborne and Waterborne Disease Outbreaks - Annual Summary 1973 (DHEW Publication No. (CDC) 75-8185) has details on 307 foodborne outbreaks and 24 waterborne outbreaks. If the neighborhood disease that might occur would be due to unusual occurrences, this outbreak investigation technique would be the only way to determine the extent of the problem although some insight might be gained by retrospective study of a large number of neighbors.

To demonstrate that there is not an endemic effect will require a prospective study of neighbors and it is my understanding that the Human Studies Laboratory of the National Environmental Research Center- RTP has such research underway.

3. Is there a significant health hazard. I do not know if there are now wastewater treatment plants of this size and process type in use that are somewhat the same distance from residents. I expect that there are some plants now in use that would represent a comparable situation but would appreciate reviewing data on this subject. Because we have not had disease outbreaks attributed to being a neighbor of a sewage treatment plant, I am of the opinion that this is not a significant health hazard.

4. Will there be an odor problem. I have smelled sewage treatment plants but have not studied the type of treatment being provided or operating conditions. I have also visited sewage treatment plants that did not have significant odor problems. I would expect that others would have more objective data on this point than the impressions I have.

5. Specific protective measures. I do not know what these should be except for the prevention of cross-connection with drinking water distribution and wash-up provision for workers.

6. Chemical emissions. I have heard of problems of hydrogen sulfite where very septic sewage reached the treatment plant. There should be plants where the wastes are from a comparable area and the sewers conveying the waste to the plant are of the same type. Data should be obtained on the quality of influent to such plants. There were problems in Philadelphia when ozone was improperly used. A few years back there were

some deaths in nearby residents when there was an escape of chlorine at a plant in Cleveland. Sodium hypochlorite is to be used for disinfection at this plant and this would eliminate the possibility of ozone or chlorine hazard.

7. Similar issues. Have not been involved with any.

Enclosure

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
National Environmental Research Center
Research Triangle Park, North Carolina 27711

SUBJECT: Questionnaire Regarding Health Hazards Associated With Wastewater Treatment Plants

DATE: February 24, 1975

FROM: OD/HSL

Dr. G.J. Love

TO: Cathy Grissom
Planning Branch, Region V

Subject questionnaire is returned herewith.

The one epidemiological study cannot be considered to be a very convincing one, but it does suggest that the hazard is probably minimal.

I am sorry I did not get the information to you as early as you wished.

Enclosure

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2
PLANNING BRANCH - Region V

EPA Form 1320-6 (Rev. 6-72)

Reproduced from best available copy.

Questionnaire

1. Are any synergistic effects known between airplane related emissions and aerosols or gases generated by activated sludge treatment processes? If so, what are these effects? no

2. What epidemiological studies have been conducted on the health of sewage treatment plant workers or residents in the area of a treatment facility? What do the results indicate? One study – copy attached.

3. In your opinion, is there any significant health hazard associated with siting a wastewater treatment plant of this size and process type in this location? Why or why not? There is some potential health hazard but too little is known to define the extent of the hazard.

4. In your opinion, will there be any significant odor problems associated with the operation of a facility such as this? Why or why not? I don't know – out of my area.

5. Is there a minimum distance and/or special protective measures which should be incorporated into the design of a treatment plant such as this to protect the workers and the adjacent residential communities from any potential health hazard? If employees are protected against hazards probably population in vicinity would also.

6. In your opinion, would a wastewater reclamation plant of this size and process type produce significant quantities of chemical emissions of a corrosive or abrasive nature? Discuss the reasons why you feel this will or will not be a problem. I don't know – out of my area

7. Are you aware of any other comparable situations where similar issues occurred? What were these issues and how were they resolved? no.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

SUBJECT: Questionaire Submitted January 16, 1975, For Use In Preparation Of A Draft Environmental Impact Statement For The Proposed O'Hare Water Reclamation Plant in Des Plaines, Illinois

DATE: 02/24/75

FROM: Clifford Risley, Jr., Director
Office of Research & Development, Region V

TO: Harlan D. Hirt
Chief, Planning Branch

At the outset it should be noted that the answers to many of these questions are based on our extensive knowledge and experience in research planning, direction, and the application of research findings to the solution of practical problems. These answers are not given on the basis of personal expertise in the field of such medically related sciences as virology, bacteriology, epidemiology, and so forth, but rather on the more practical aspects of sanitary waste disposal and the chemical and engineering factors related to this practical application. We have read extensively in the areas of work done in these other fields of medically related sciences and are thoroughly familiar with much of the work done as it relates to sewage treatment plants. However, the opinions we express in answer to such questions are based on the work of experts in those fields, as we interpret their findings.

Question No. 1: We know of no synergistic effects reported between airplane related emissions and aerosols or gasses generated by activated sludge treatment processes.

Question No. 2: We know of no epidemiological studies that have been conducted to date on the health of sewage treatment plant workers or residents in the area of treatment facilities. It is our understanding that a project to study the basic effects of such problems on sewage treatment workers is about to begin at the University of Cincinnati.

Question No. 3: We know of no factual information that establishes any significant health hazard associated with siting a waste treatment plant of this size and process type in any location.

Question No. 4: Odors have resulted from improperly operated sewage treatment plants of similar design; however, this particular plant has designed into it several safety factors and back-up facilities for prevention of odors. If the plant is properly operated and properly maintained, the probability of odor coming from this plant is essentially negligible.

Question No. 5: We know of no established minimum distance or special protective measures which can be recommended for incorporation into the design of the treatment plant based on present knowledge of the need to protect workers and adjacent residential communities from potential health hazards.

Question No. 6: We know of no prior studies establishing that a wastewater reclamation plant of this size and process type would produce significant quantities of chemical emissions of a corrosive or abrasive nature. Plants of similar design are operating throughout the country and have been for several years with no recorded detrimental effects. Whether or not such emissions occur is probably directly related to the proper operation of the plant. Safeguards have been included in this plant design to assure the prevention of release of an undue amount of chemical emmisions and to assure proper operations at all times.

Question No. 7: Similar discussions regarding potential problems arising from various plants occur frequently. It cannot be assumed that the potential problems suggested for other plants can be directly applied to this plant as problems also. We know of no instances where identical situations and identical problems have come up for discussion.

It should be noted that many previous studies have been made of bacteria, virus, and toxic materials originating in sewage treatment processes. Any one of these studies taken as a separate isolated situation might be interpreted as a potentially alarming problem to someone not directly involved in the utilization of such information. The Public Health Service and many medical groups have been carefully scrutinizing these individual problems for many years for the purpose of avoiding the development of epidemics or similar catastrophic problems related to the general public. Reliance must be placed in the hands of such Public Health officials to take these individual pieces of scientific information for their respective values and to put them into perspective in terms of public need. For us to attempt to make such an interpretation at this time is not in the interest of everyone concerned because of the many areas of this type of research that are presently uninvestigated. We therefore recommend diligence in the pursuit of this missing information but also recommend avoiding conclusions that are not justified based on known facts at this time.

Clifford Risley Jr

Clifford Risley, Jr.

THE CITY OF DES PLAINES
COOK COUNTY, ILLINOIS
MEMBER ILLINOIS
MUNICIPAL LEAGUE

RICHARD F. WARD
Alderman 8th Ward
1410 Miami Lane
Des Plaines, Illinois 60018
(AC 312) 827-8715

February 18, 1975

Mr. Gene Wojcik, Planning Branch
U.S. Environmental Protection Agency
230 South Dearborn Street
Chicago, Illinois 60604

Dear Mr. Wojcik,

Thank you for sending a copy of your health questionnaire that I received on January 30, 1975. With the exception of question #6, all of the other references listed below are contained in our December 27, 1974 comments on the proposed MSD O'Hare projects and are presented here for your convenience.

1. Synergistic effects: Para 3.8A, Rogoff Att. Z, Argonne Report, Para 3.8C, Carnow Att.AA, Para 3.8F, Para 2.13(8-14-71)

2. Studies: Para 3.11B, Att#7, Para 5.5C, Para 3.5, Berg Att Y, Para 3.6, Ledbetter Att V

3. Site: Para 2.3(Epstein), Para 2.21A, Para 3.8D, Para 3.8E (Blanchard)

4. Odor: Para 4.1F, Barbolini Att#10, Para 3.9, Att.DD, Att.EE, Para 3.10A, Herr Att#6, Para 3.11, Att.GG, Para 3.11A, Para 3.12, Consoer Att.HH, Para 4.1J, Para 3.14D, Metcaff Att#8, Para 3.14E, Para 3.14I.

5. Distance and/or protective measures: Para 3.14H, Para 4.13, Para 3.11, Greenley Att.GG, Para 5.11A,B,G.

6. Chem. Emissions - corrosive or abrasive: "corrosion of some building materials during construction" July, 1973 MSD Initial Draft of EA on alternative TARP plans.
"Mystery Spots Plague Suburb" Chicago Sun Times 9/7/67 page 32, Gasses and odors from MSD's Orland Park STP caused paint to discolor on nearby homes.

7. Comparable situations: Para 1.0B, Clavey EIS Att.B, Para 3.9A, Sacramento Att#5, Para 3.9B, Eli Lilly Att#6, Para 3.13, Para 4.13.

Please include our input with the answers you have received from the MSD and other respondents.

Sincerely,

Richard F. Ward

Richard F. Ward

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
ATLANTA, GEORGIA 30333
TELEPHONE: (404) 633-3311

February 26, 1975

Harlan Hirt, Chief
Planning Branch, Region V
U.S. Environmental Protection Agency
230 South Dearborn Street
Chicago, IL 60604

ENVIRONMENTAL PROTECTION AGENCY
RECEIVED
MAR 3 1975
PLANNING BRANCH - Region V
FILE NO.

Dear Mr. Hirt:

Reference is made to your letter of January 16 and to the attached questionnaire.

My answers to your questions concerning the proposed O'Hare Water Reclamation Plant in Des Plaines are as follows, using the same numbering system you used:

1. I don't know.

2. I don't know of any. However, the following references are related: Gellin and Zavon, Arch. Env. Hlth 20: 510, 1970; Browning and Gannon, JWPCF 35: 186, 1963; and Dixon and McCabe, JWPCF 36: 984, 1964.

3. I have no knowledge of significant health hazards, but definitive studies to determine if such health hazards exist have not been conducted.

4. In my opinion, it is probable that there will be odor problems associated with a facility such as described in your attachments to your letter, because I have never yet seen a large sewage-treatment plant that does not from time to time produce odor problems.

5. Until a definitive, controlled study is done on the health of workers in sewage-treatment plants (a contract study on the health of sewer maintenance workers will be undertaken by EPA shortly), there is no answer available to this question. Even then, a controlled study of the health of the residents near sewage treatment plants may also be necessary to answer the question. Workers in sewage treatment plants should practice careful handwashing and care of minor wounds, and they should have recommended immunizations (at least polio and tetanus).

6. I don't know.

7. I am not personally aware of any comparable situations.

If I can be of further assistance at any time, please let me know.

Sincerely yours,

G F Mallison

G. F. Mallison, Assistant Director
Bacterial Diseases Division
Bureau of Epidemiology

APPENDIX E

BEDROCK GEOLOGY

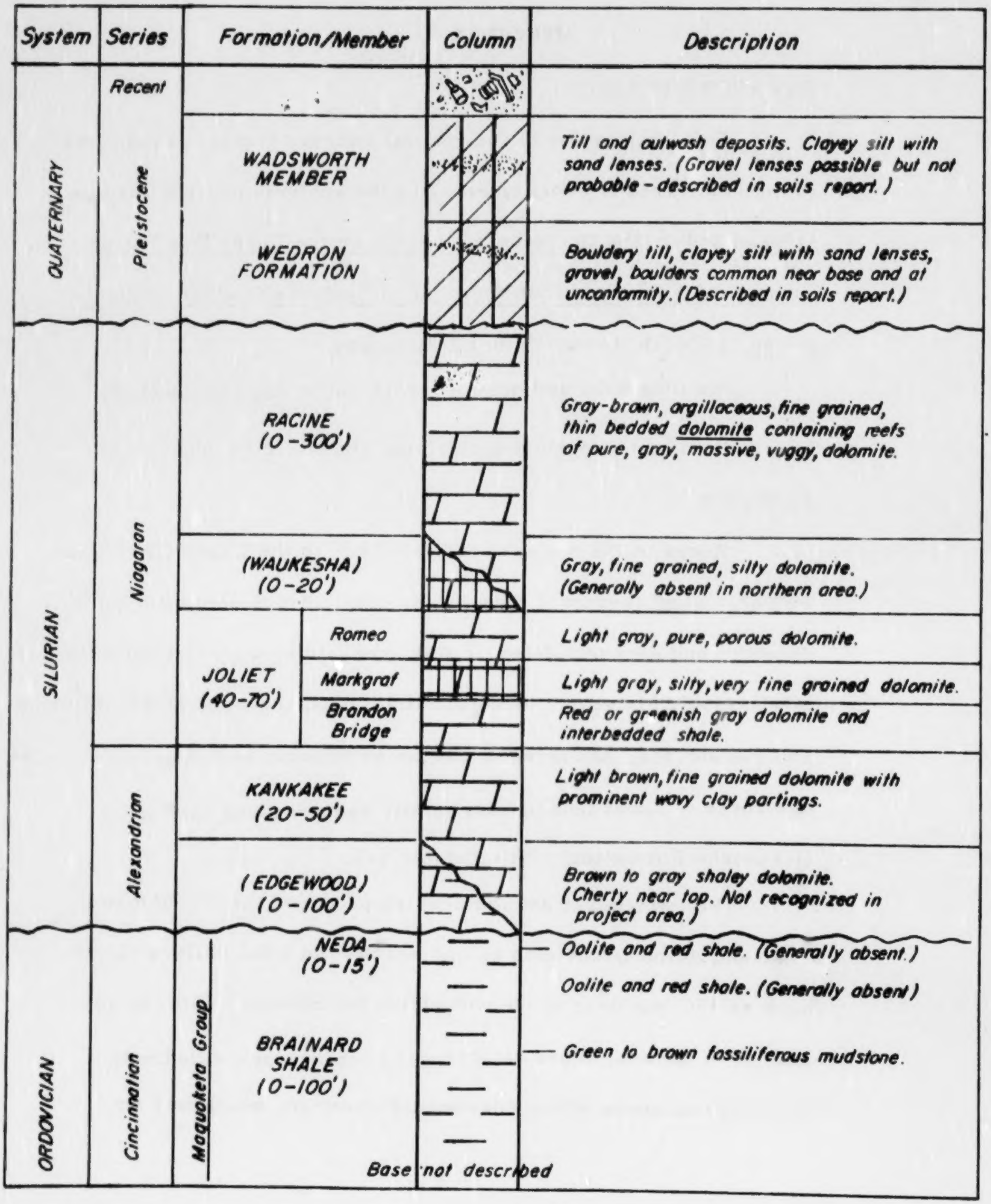
This description of the general bedrock geologic conditions in the study area is complemented by the analysis of field borings as reported in The Geotechnical Report on the Upper Des Plaines Tunnel and Reservoir Plan, Volume 1, Bedrock Geologic Investigation, 1974, De Leuw, Cather & Company.

The limestone and dolomite rock units, together with the hydraulically interconnected overlying glacial drift, function as an aquifer.

Rocks in the project area date back to the Upper Ordovician Period. They consist of mudstones, argillaceous dolomite, pure dolomite and unconsolidated or semi-consolidated glacial deposits. Stratigraphic hiatuses (disconformities) occur between Middle Silurian and Pleistocene, and between the Lower Silurian and Upper Ordovician age rocks. Local lensing may totally remove some rock units (Waukesha Formation). See Exhibit II-1.

The lowering of sea level which produced the disconformity at the end of the Ordovician period resulted in local valleys cut as much as 150 feet deep in the underlying mudstones. With the re-advance of the sea, these valleys were subsequently filled with the shaley dolomite of the Edgewood Formation, which was not

EXHIBIT II-1



System	Series	Formation/Member		Column	Description
QUATERNARY	Recent				
	Pleistocene	WADSWORTH MEMBER			Till and outwash deposits. Clayey silt with sand lenses. (Gravel lenses possible but not probable - described in soils report.)
		WEDRON FORMATION			Bouldery till, clayey silt with sand lenses, gravel, boulders common near base and at unconformity. (Described in soils report.)
SILURIAN	Niagaran	RACINE (0-300')			Gray-brown, argillaceous, fine grained, thin bedded dolomite containing reefs of pure, gray, massive, vuggy, dolomite.
		(WAUKESHA) (0-20')			Gray, fine grained, silty dolomite. (Generally absent in northern area.)
		JOLIET (40-70')	Romeo		Light gray, pure, porous dolomite.
			Markgraf		Light gray, silty, very fine grained dolomite.
			Brandon Bridge		Red or greenish gray dolomite and interbedded shale.
	Alexandrian	KANKAKEE (20-50')			Light brown, fine grained dolomite with prominent wavy clay partings.
		(EDGEWOOD) (0-100')			Brown to gray shaley dolomite. (Cherty near top. Not recognized in project area.)
ORDOVICIAN	Cincinnatian	Maquoketa Group	NEDA (0-15')		Oolite and red shale. (Generally absent.)
					Oolite and red shale. (Generally absent)
			BRAINARD SHALE (0-100')		Green to brown fossiliferous mudstone.

Base not described

STRATIGRAPHIC SEQUENCE

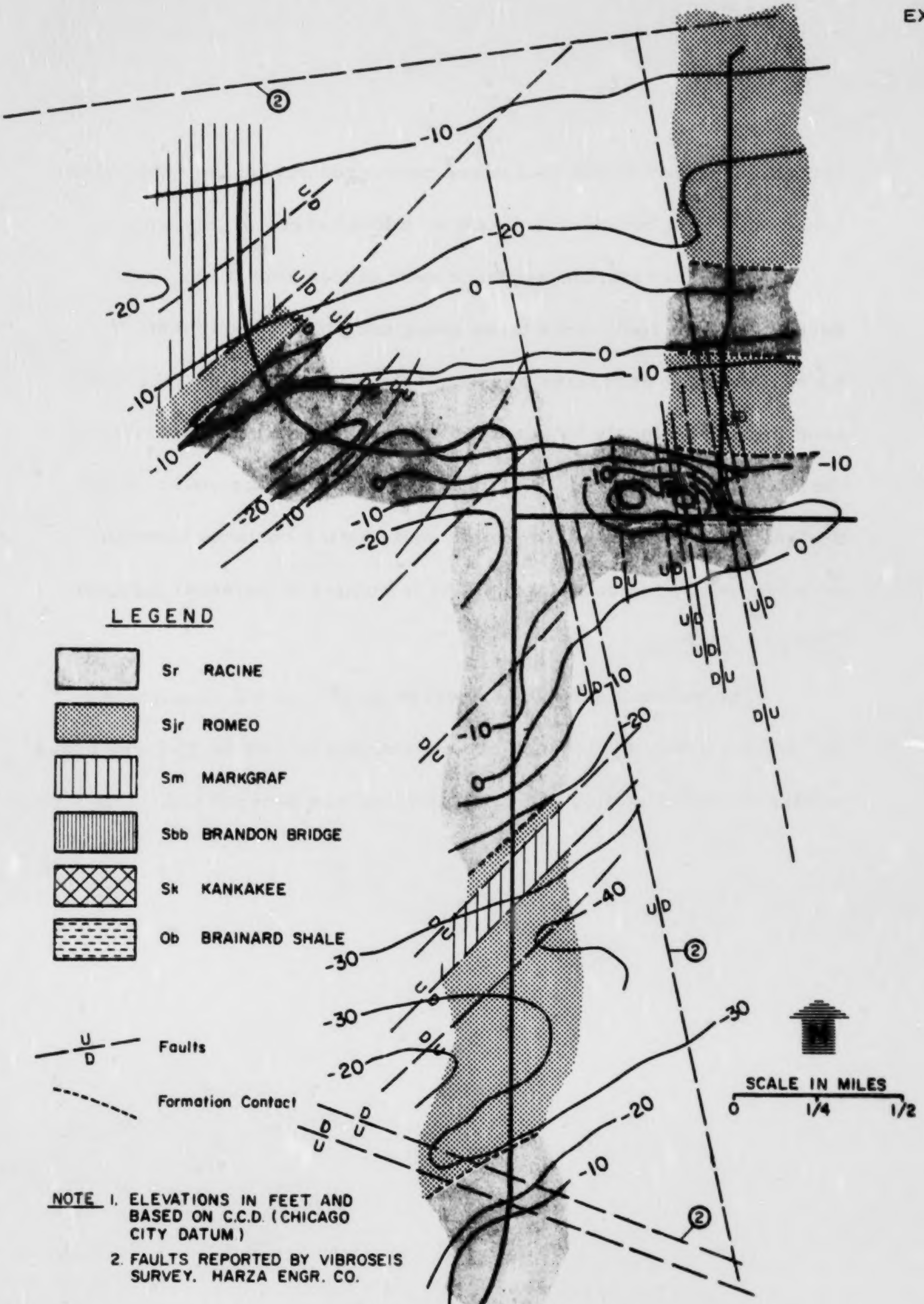
recognized in any of the rock cores recovered during the explorations reported herein, but which may exist in local areas of the project.

The stratigraphic sequence used in this report has been developed from rock cores taken along the project alignment. No surface rock exposures are available for study. The rock units used follow as closely as possible formational units as described in the literature (Willman, 1971 and 1973), but vary somewhat in the designation of formational member units as the contacts between member units are gradational and thus subject to personal judgment.

Bedrock Surface

The bedrock surface is covered by glacial till throughout the project area; the bedrock contours shown in Exhibit II-2 are based totally on interpretation of boring data and are generalized. The

EXHIBIT II-2


LEGEND
Sr RACINE
Sjr ROMEO
Sm MARKGRAF
Sbb BRANDON BRIDGE
Sk KANKAKEE
Ob BRAINARD SHALE
U D Faults
Formation Contact
SCALE IN MILES
0
1/4
1/2
N
②
-10
-20
0
-30
-40
U D
D U

NOTE 1. ELEVATIONS IN FEET AND BASED ON C.C.D. (CHICAGO CITY DATUM)

2. FAULTS REPORTED BY VIBROSEIS SURVEY. HARZA ENGR. CO.

CONTOURS ON TOP OF ROCK AND BEDROCK GEOLOGY

bedrock relief in the project area is over 60 feet.

The rock units at the till/rock contact are the Niagaran age dolomites of the Racine and Joliet Formations. The top of rock surface is usually broken and open for five to ten feet and occasionally carries significant quantities of water.

Stratigraphy

A detailed discussion of the stratigraphy of the study area can be found in the Foundation Science Report, A Geotechnical Report on the Upper Des Plaines Tunnel and Reservoir Plan, prepared for De Leuw, Cather & Company.

Structure

The geologic structure described in this report is based solely on interpretation of boring data. No exposures of bedrock are available for study in the project area. Therefore, the situation presented in maps and sections must be used in its broad diagrammatic sense only.

Faults. A number of faults of ten to 30 feet vertical offset are postulated. The faults are interpretive and have not been physically observed, but they do further explain stratigraphic facts developed by the boring program. None of the borings actually intersected a major fault zone. In many cases, stratigraphic offsets of a single fault are probable--the result of more than one fault of smaller proportion stair-stepped to produce the total offset.

With borings spaced at 1,000-foot centers, as in this program, it is also possible for fault blocks of greater or lesser proportion than those shown to exist between borings and not be represented on geologic maps and sections. The general structural trend for faults is expected to be NE-SW and NNW-SSE. The actual fault trends indicated on the accompanying map are interpreted from apparent bedrock drainage displacements and may or may not in fact represent actual conditions.

Three angle borings were drilled to try to sample a fault zone. No significant amounts of faulted or gouged rock could be identified in any of these holes although a few core loss zones occurred which may represent small shear zones. However, the rock on either side of the core loss zones does not appear bisected as might be expected if a major fault zone were nearby.

The Des Plaines Disturbance. The project is immediately west of a geologic anomaly known as the Des Plaines Disturbance. This disturbance is a five- and one-half-mile-diameter area having a very complex system of high-angle faults. Fault displacements along the edges of the disturbance range from 50 to 300 feet, and in the interior reach 900 feet. Thus, faulting may be aptly described as severe, and the fault system may be expected to extend some considerable distance away from the boundary of the disturbance. Shear zones associated with the fault system would cause support problems and would yield high volumes of water. Because of the anticipated areal faulting, water infiltration problems would probably be severe. Also, because of the offsets across individual faults, it would be difficult to avoid the contacts between rock members, again adding to water inflow and support problems.

Jointing. Joints, although not numerous in the rock, have a significant influence on its permeability and local tunnel stability. The open joints act as a conduit to carry groundwater from the overlying glacial till to the bedding planes in the upper rock units (Racine and Joliet Formations). The numbers of the open joints are relative indicators of the amount of groundwater to be expected in a given rock. These data clearly demonstrate the more open and permeable natures of the Racine and Upper Joliet (Romeo) Formations.

Earthquakes. In the past, damage from earthquakes has not been extensive or severe in Northern Illinois. Past disturbances have ranged in intensity up to VII on the Mercalli scale, but a VII intensity was recorded only once in history. Presently, the study area is in Seismic Risk Zone 1, an area predicted to experience only minor damage from earthquakes that have the epicenters outside the state. Intensities of the disturbances are predicted to range from V to VI on the Mercalli scale. A V intensity disturbance is felt by nearly everyone and breaks glassware and windows. A VI intensity disturbance is felt by everyone; objects are upset; and chimney and plaster damage occurs.

SOILS AND SURFICIAL GEOLOGY

The basic drainage patterns, landforms and soil parent materials are related to the Wisconsin glaciation. Glacial deposits may approach depths of 60 feet in this area. The textural composition of these morainal till deposits range from clay to clayey silt, with varying amounts of sand, gravel and boulders. At the earth tunnel depth, the soils range from clayey silts to silty clays, with occasional sand and gravel. In this area, the Tinley Moraine directly overlies the Valparaiso Moraine. The Tinley Moraine, predominately a silty clay, may contain waterbearing sand layers.

REGIONAL WATER RESOURCES AND NEEDS

SECTION A

Sources of Water Supply

2.01 GENERAL At the present time, Lake Michigan and groundwater are the sources for public water supply in northeastern Illinois. Groundwater is developed from four aquifer systems: 1) sand and gravel deposits in the glacial drift; 2) shallow dolomite formations; 3) the Cambrian-Ordovician aquifer; and 4) the Mt. Simon aquifer. For purposes of this report, the sand and gravel deposits and the dolomite formations are collectively referred to as the shallow aquifers, while the Cambrian-Ordovician aquifer is referred to as the deep sandstone aquifer. The Mt. Simon aquifer is considered separately and discussed to a lesser degree because it is virtually unused at present. While there are several surface streams flowing through the region, only the Kankakee River has been seriously considered as a source of public water supply.

2.02 LAKE MICHIGAN Lake Michigan is the most extensively used water source. It provided 1,105 million gallons per day (MGD) for public water supply in 1970, or about 85 percent of the region's total public water supply needs.(1) From a purely physical standpoint, the Lake offers an almost limitless amount of water that can be readily treated to acceptable drinking water quality. It should be noted that no water flows naturally from the Lake to the region. That which is withdrawn for water supply and other purposes constitutes a diversion. Currently, this diversion is limited to 3,200 cubic feet per second (cfs), or about 2,080 MGD, as a result of a 1967 U.S. Supreme Court Decision.

The City of Chicago is the largest user of Lake Michigan water, withdrawing amounts to meet its own needs as well as those of 72 suburban communities in Cook County which purchase water under contract. Additional water is withdrawn by fourteen other public water supply systems located along the Lake Michigan shoreline in Cook and Lake Counties; service by those systems is usually limited to one or two communities. Given the expected future development of the region, coupled with decreased groundwater availability in certain areas, the Lake will be more heavily relied upon for public water supply in the future.

2.03 SHALLOW AQUIFERS The shallow aquifer system in northeastern Illinois is comprised of unconsolidated sand and gravel deposits of the glacial drift and dolomite formations, mainly of Silurian age. Although these aquifers are hydraulically interconnected, their characteristics are sufficiently different to warrant separate discussion.

a. Sand and Gravel Aquifers The sand and gravel aquifers randomly underlie approximately 50 percent of the region at depths ranging from near the land surface in certain areas to more than 400 feet in others. (Figure 2-1 is a cross-sectional illustration of

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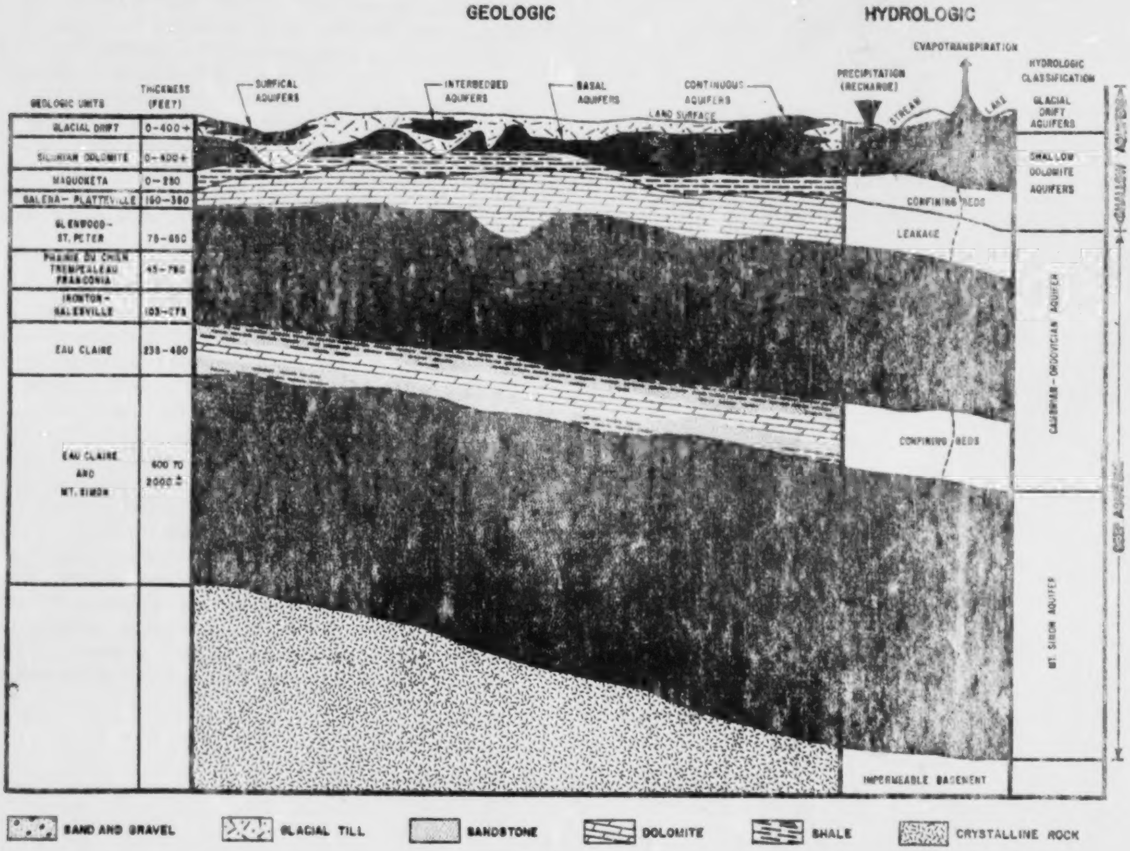
(1): Ref. 1, pg. 3

Figure 2-1 **The Groundwater Aquifers of Northeastern Illinois**


GEOLOGIC
HYDROLOGIC
GEOLOGIC UNITS
THICKNESS (FEET)
GLACIAL DRIFT
0-400+
SILURIAN DOLOMITE
0-400+
MAQUOKETA
0-250
GALENA-PLATTEVILLE
160-380
GLENWOOD-ST. PETER
75-650
PRAIRIE DU CHIEN TREMPEALEAU FRANCONIA
45-750
IRONTON-GALESVILLE
103-275
EAU CLAIRE
235-480
EAU CLAIRE AND MT. SIMON
600 TO 2000±
SURFICAL AQUIFERS
INTERBEDDED AQUIFERS
BASAL AQUIFERS
CONTINUOUS AQUIFERS
LAND SURFACE
PRECIPITATION (RECHARGE)
EVAPOTRANSPIRATION
STREAM
LAKE
CONFINING BEDS
LEAKAGE
CONFINING BEDS
IMPERMEABLE BASEMENT
HYDROLOGIC CLASSIFICATION
GLACIAL DRIFT AQUIFERS
SHALLOW DOLOMITE AQUIFERS
CAMBRIAN-ORDOVICIAN AQUIFER
MT. SIMON AQUIFER
SHALLOW AQUIFERS
DEEP AQUIFERS
SAND AND GRAVEL
GLACIAL TILL
SANDSTONE
DOLOMITE
SHALE
CRYSTALLINE ROCK

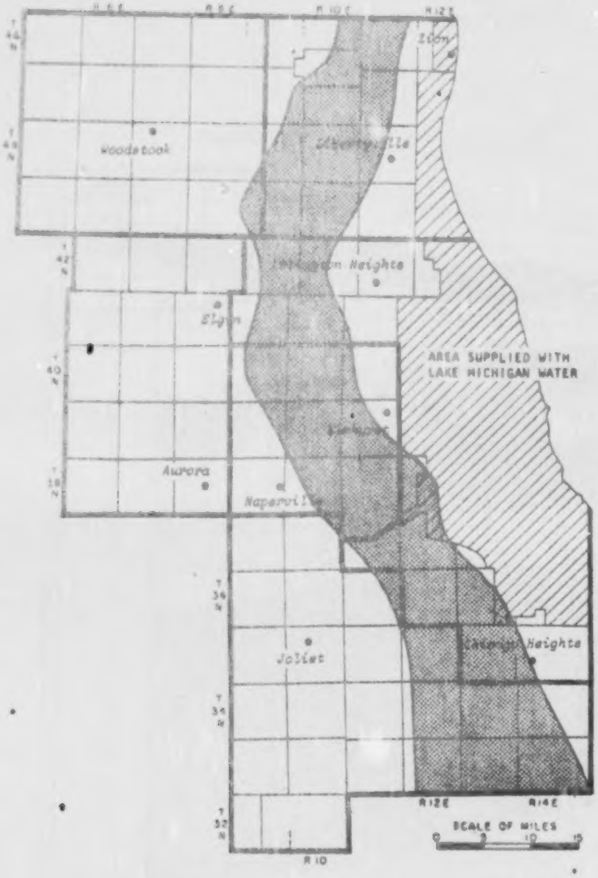
the entire regional aquifer system.) Extensive surficial sand and gravel deposits are found in parts of DuPage, Kane, Lake, McHenry and Will counties, while deeply buried deposits are found widely scattered throughout Kane and McHenry counties, western Lake County, northeastern Cook and DuPage counties and central Will County. Generally, the greatest chance for successful well penetration of a productive water yielding sand and gravel formation is within subsurface valleys cut into the bedrock by preglacial and glacial geological processes.

Because of their irregular occurrence, the sand and gravel aquifers are more difficult to locate than the deeper, more extensive sandstone aquifers. They are also more difficult to develop for large water supply systems since they are more directly affected by the vagaries of rainfall and drought. On the other hand, the glacial drift aquifers are generally more rapidly recharged, are more permeable than the deep aquifers, and involve lower drilling costs. Locally they provide good sources of supply to municipalities and private individual users, with some wells yielding in excess of 1,000 gallons per minute (gpm). In 1970, approximately 31.4 MGD were pumped from the sand and gravel aquifers in the six-county region. This amounted to approximately 12 percent of the estimated total groundwater pumpage in that year, which was 261.2 MGD.(2)

The hardness content of raw water is extremely variable but usually ranges between 100 parts per million (ppm) and 450 ppm. The iron content which can affect the taste, appearance and use of water averages about 2 ppm and is higher than that of the deep aquifers and Lake Michigan. Water temperatures average about 52 degrees, which is considered to be cool and refreshing.

b. Dolomite Aquifer Underlying much of the region at depths varying from ground surface to 450 feet deep is the shallow dolomite aquifer. In this aquifer groundwater is found in joints and fractures, and it moves through an interconnected network of these openings. Since these water-bearing cavities are unevenly distributed both horizontally and vertically, the yields of wells drilled into the dolomite vary greatly from place to place. Successful development for water supply depends upon a well intersecting a large, water-filled fracture which is capable of sustaining heavy pumpage over time. Some wells drilled into dolomite yield in excess of 1,000 gpm, while others result in very low yields. Figure 2-2 shows the general area of highest yields from this formation.

Figure 2-2 Area of High Yield from the Shallow Dolomite Aquifer



Adapted from map prepared by Alvord, Burdick and Howson Engineers

The dolomite aquifer is an extensively used source of water supply for many municipalities, particularly in DuPage County and southern and northwestern Cook County. In 1970, total pumpage from the dolomite was estimated at 90.7 MGD, which was approximately 35 percent of the region's groundwater withdrawal.(3) In several areas, the aquifer is being pumped in excess of recharge, and there have been significant declines in water levels and well yields.

c. Estimates of Potential Yield Potential yield is defined as the maximum amount of water that can be developed from a reasonable number of wells and well fields without creating critical water levels or exceeding the rate of groundwater recharge. The Illinois State Water Survey has estimated the potential yield of the shallow aquifers (sand and gravel and dolomite combined) at 507 MGD, assuming they are fully developed in the six-county area.(4) According to the total shallow aquifer pumpage figures noted above, only 122.1 MGD were withdrawn in 1970. Thus, on a regionwide basis the shallow aquifers are currently producing only about 25 percent of their potential yield, and there is greater opportunity for increased development of them for future water supply.

2.04 CAMBRIAN-ORDOVICIAN AQUIFER The Cambrian-Ordovician (or deep sandstone aquifer) is regarded as the best bedrock aquifer in Illinois because of its consistently high yield. It extends continuously throughout the region and is uniformly productive. This aquifer is actually a vertical series of water-bearing rock formations, of which the Glenwood-St. Peter and Ironton-Galesville sandstones are the principal producers. The latter is considered to be the most productive and supplies over 50 percent of the aquifer's total yield. Because this aquifer has a regional southeasterly dip of about 10 feet per mile, the top of the Ironton-Galesville sandstone lies about 500 feet below the land surface in the northwest corner of the region and increases to a depth of about 1,800 feet in the southeastern part. The saturated thickness of this aquifer varies from approximately 100 feet to about 275 feet, while the average collective thickness of the geologic formations comprising the aquifer is about 1,000 feet. It is significant to note that while some recharge of the deep sandstone occurs in western Kane and McHenry counties, most takes place in areas outside of the metropolitan region, including Kendall, Boone and DeKalb counties of Illinois, and in certain areas of southeastern Wisconsin. It is important that future urbanization and land use in those areas not have an adverse impact on recharge.

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(2): Ref. 2

(3): Ref. 2

(4): Ref. 3

The Cambrian-Ordovician aquifer is the most heavily pumped aquifer in the region; it furnished approximately 53 percent of the total groundwater used in 1970. Since 1958, withdrawals from this aquifer have exceeded the practical sustained yield, which is defined as the maximum amount of water which can be continuously withdrawn from existing pumping centers without eventually dewatering the most productive unit (i.e., the Ironton-Galesville standstone). The practical sustained yield of the Cambrian-Ordovician aquifer has been estimated at only 46 MGD. Pumpage data for 1970 indicates that actual withdrawals approximated 139 MGD, or about three times the estimated sustained yield.(5) This withdrawal of water at rates in excess of natural recharge (termed "mining") has been reflected by a progressive decline in water levels, increased pumping lifts and increases in pumping costs. During the period 1966-1971, annual water level declines in wells in the Cambrian-Ordovician aquifer averaged nine feet.

Table 2-1 lists the increases in pumpage from the deep sandstone aquifer during the period 1966-1971.

TABLE 2-1: PUMPAGE FROM DEEP WELLS IN NORTHEASTERN ILLINOIS, 1966-1971 (IN MGD)(6)

	Public Supplies		Industrial Supplies		Total	
County	1966	1971	1966	1971	1966	1971
Cook	31	42	24	17	55	59
DuPage	11	16	1	1	12	17
Kane	23	26	3	2	26	28
Lake	2	5	1	2	3	7
McHenry	2	2	1	1	3	3
Will	12	14	16	14	28	28
Total Region	81	105	46	37	127	142

While industrial pumpage declined over the five-year period, total pumpage actually increased 15 MGD as a result of greater withdrawals for public supply. Particularly noticeable are the increases in public pumpage in Cook and DuPage counties.

Despite the problem of overpumpage, the Cambrian-Ordovician aquifer will continue to be an important source of supply. Water in this system is naturally free of bacterial pollution. The hardness content is from 200 to 250 ppm in the northwest part of the region, and increases toward the east as the aquifer increases in depth. The iron content of the water is usually less than 0.4 ppm. Temperatures range from 54 to about 62 degrees and increase with depth. The Cambrian-Ordovician aquifer is generally well suited for large, municipal water systems; yields in excess of 1,000 gpm have been recorded. Mining of this aquifer cannot be continued indefinitely. Eventual provision must be made for transfer to an alternative or supplemental source in areas where water levels and well yields are declining.

2.05 MT. SIMON AQUIFER The Mt. Simon aquifer underlies the Cambrian-Ordovician system and is the deepest in the region. The top of this aquifer ranges from 1,400 to 1,600 feet below the ground surface in the northwest, and from 2,200 to 2,400 feet in the southeast. Its average thickness is approximately 1,600 feet, with the materials consisting primarily of fine to coarse grained sandstone. The cleaner parts of the sandstone yield moderate quantities of water, although the aquifer's potential is limited by a number of factors. The most significant limitation is brackish water beginning at depths below 1,300 feet mean sea level, necessitating costly treatment prior to use. The aquifer also is not consistently permeable. Furthermore, deep and expensive wells are involved.

The practical sustained yield of the Mt. Simon aquifer has been estimated at 14 MGD, although development of this source has been virtually nonexistent to date. In 1973, the Illinois State Water Survey completed a feasibility study of developing and desalting water from the Mt. Simon aquifer. Reverse osmosis and freezing processes were considered feasible for 1 MGD capacity treatment plants, while distillation was considered feasible for 5 MGD plants. Costs (including wells, transmission lines, desalting facilities and brine disposal) ranged from $1.33/1,000 gallons for a 1 MGD reverse osmosis plant to $1.85/1,000 gallons for a 5 MGD distillation plant.

2.06 SURFACE WATER RESOURCES Unlike many other large metropolitan areas, no inland lakes, rivers or streams are presently used for public water supply in northeastern Illinois. There is, however, substantial industrial use of water from the Sanitary and Ship Canal, the Calumet River, the Des Plaines River and, to a lesser extent, the Fox River.

a. Limitations There are several factors which have mitigated against the use of surface watercourses. Certainly one reason (at least until recently) has been the readily available supply of groundwater which could be developed at low cost. But the major deterrent has been the general poor quality of the region's surface waters, a problem which necessitates thorough, expensive treatment. While water treatment technology has advanced to the point where virtually any water can be made potable, the cost of such treatment may be excessive, especially when compared with the cost of developing alternative sources. Waterways such as the Des Plaines River have been discounted as viable sources of municipal water supply because of their lack of dependable flow, high concentrations of bacterial and viral organisms, high solids and heavy metals content, and undesirable tastes and odors.

Nevertheless, the suitability of these waters should be periodically reevaluated in light of changing needs and conditions. As improved methods of wastewater treatment are employed and as nonpoint sources of pollution are reduced, surface waterways may become economically feasible and attractive water sources. In the interim, greater attention could be given to increased use of these waters for non-domestic purposes whenever possible in order to alleviate competitive pressures on water resources which are suitable for public supply.

b. Kankakee River It should be noted that the Kankakee River is an exception to the foregoing discussion and does offer potential for development as municipal supply. The river's raw water quality is reasonably good, and its large flow volume would eliminate the need to construct expensive storage reservoirs. In addition, it is proximately located to the Joliet area where there is concern for the long-term availability of groundwater.

c. Fox River At the present time it is not advisable to use the Fox River for domestic purposes since a high percentage of its flow consists of wastewater treatment plant effluent which presents a risk of viral or chemical contamination.(7) However, the Fox River may offer some potential for future use as a public water supply. Indeed, state water quality standards have designated the river for "domestic and food processing water supply," and pollution abatement efforts necessary to achieve that standard are underway. After the desired level of water quality has been attained, the river might be used for this purpose. One possible approach would be to reduce deep well pumpage in the Fox Valley area to the rate which can be sustained without mining. Demands which could not be satisfied by groundwater under this condition could be compensated for through withdrawals from the river. During seasonal low streamflows, well pumpage could be increased beyond sustained yield on a short-term basis until normal flows are resumed.

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(5): Ref. 2

(6): Ref. 4, pg. 8

(7): Ref. 5

d. Other Streams Finally it is significant to note that while there are a large number of tributary streams in northeastern Illinois, few present public water supply opportunities. In addition to quality problems, frequent periods of low flow would necessitate the construction of storage reservoirs, a condition for which the topography of this region is poorly suited. There are also problems of leakage in these reservoirs through permeable surficial materials or fractured bedrock, and excessive sedimentation. Sites which have been identified as being potentially suitable for water supply reservoirs are discussed in Appendix D.

SECTION B

Water Supply By County

2.07 GENERAL This section contains summary descriptions of water supply conditions in each of the six counties in the region. Particular emphasis has been placed on groundwater, since areas now supplied by groundwater are expected to face the most serious problems in both the immediate and distant future. The groundwater data used in this section were furnished by the Illinois State Water Survey; the information is thought to be the most accurate presently available. Total pumpage figures are cited, including amounts used for the following purposes: public (which includes municipal, subdivision and institutional); industrial; domestic; irrigation; and livestock. The amounts used for the last two purposes are difficult to quantify and are not thought to be substantial. Estimates of the potential yields of the shallow aquifers in each county were also made by the Water Survey.

2.08 COOK COUNTY Lake Michigan is the predominant source of supply for Cook County. The City of Chicago withdraws water from the Lake to supply its own needs and in addition furnishes water on a contractual basis to a number of suburban communities. In 1970, the City provided an average of 1,035 MGD to supply 4.52 million people in its service area. There are six other independent municipal systems located along the north shore which withdraw Lake water. Lansing, in the southeastern part of Cook County, obtains Lake water via the Hammond, Indiana, system.

A significant portion of Cook County is supplied with groundwater. In 1970, pumpage amounted to 99.6 MGD, which was approximately 38 percent of the six-county total groundwater pumpage of 261.2 MGD in that year. Of the 99.6 MGD, 59.6 MGD (60 percent) were taken from the deep sandstone aquifer, 36.4 MGD (36 percent) from the dolomite, and 3.7 MGD (4 percent) from the shallow sand and gravel.

Deep sandstone pumpage in Cook County is more than twice that in any other northeastern Illinois county. Water well levels have declined in response to heavy drawdowns, particularly in the northwest and southern portions. There is also significant pumpage from the shallow aquifers, especially in the southern sector. Chicago Heights, and to a lesser extent LaGrange, have been identified as areas where pumpage has exceeded recharge. Countywide, the estimated shallow aquifer potential yield is 98 MGD.

2.09 DU PAGE COUNTY DuPage County is supplied exclusively with groundwater, and pumpage in 1970 averaged 51.7 MGD. The dolomite accounted for 33.9 MGD of the total withdrawal (66 percent), while the deep sandstone yielded 15.5 MGD (30 percent) and the sand and gravel aquifers 2.3 MGD (4 percent).

There is considerable concern for the long-term adequacy of groundwater supplies in DuPage County. The potential yield of the sand and gravel and dolomite aquifers is estimated at 42 MGD and by 1972, pumpage from these aquifers had increased to 39.7 MGD. In some areas (most notably in the vicinities of Hinsdale, Clarendon Hills, Addison, Downers Grove, Wheaton and Glen Ellyn) the dolomite is already being pumped in excess of recharge, and there has been permanent lowering of the water table and reductions in well yields. In an effort to compensate for these declines, increased numbers of deep sandstone wells have been drilled. Extensive mining is being practiced, and water levels in the deep wells have been declining steadily for several years.

2.10 KANE COUNTY Kane County is supplied primarily with groundwater, although there is some minor industrial use of the Fox River. The western two-thirds of the county is largely rural, and no particular water supply problems are being experienced. However, in the more urbanized Fox River Valley area, the Cambrian-Ordovician aquifer is heavily used, and steady water level declines have been observed, particularly in Aurora and Elgin.

The importance of the deep sandstone aquifer is illustrated by the fact that it provided 27.9 MGD (or 74 percent) of the 37.5 MGD total pumpage in 1970. The sand and gravel and shallow dolomite aquifers produced 6.2 MGD (17 percent) and 3.4 MGD (9 percent) respectively. Their potential yield is estimated as 31 MGD, which is the lowest of the six counties.

2.11 LAKE COUNTY Lake Michigan is the primary source of supply in eastern Lake County, while groundwater is used in the central and western portions. In terms of total groundwater pumpage, development of the three aquifer systems has been approximately equal. According to 1970 pumpage figures, withdrawals amounted to approximately 19 MGD. The sand and gravel aquifers produced 6.9 MGD (36 percent) of the total, followed by 6.1 MGD (32 percent) from the dolomite and 6.0 MGD (32 percent) from the deep sandstone.

Water level declines in the deep wells are being experienced in certain areas (primarily Libertyville and Mundelein), although this situation is not as severe as that in Cook and DuPage counties. There appear to be considerable opportunities for greater development of the shallow aquifers, where potential yield is estimated at 51 MGD.

2.12 MC HENRY COUNTY Of the six counties, McHenry is in the most favorable position with respect to water supply. The sand and gravel aquifers are by far the predominant source and their use is increasing. They supplied 9.4 MGD (or 63 percent) of the county's 15 MGD total pumpage in 1970. By way of contrast, the deep sandstone produced 3.0 MGD (20 percent) and the dolomite produced 2.6 MGD (17 percent).

It is significant that the combined potential yield of the shallow aquifers is estimated at 96 MGD. Thus, while the shallow aquifers provided 12 MGD (or 80 percent) of McHenry County's total 1970 groundwater demand, this still amounted to only about 13 percent of the total quantity potentially available to the area from the shallow system.

raising Lakes Michigan and Huron by 4.4 inches, excluding the effects of the Illinois diversion. ~~The effect of the present Illinois diversion (exclusive of the diversion into Lake Superior) is to lower Lakes Michigan and Huron 2.7 inches. The net effect of these in-and-out diversions is to raise the levels of Lake Michigan and Lake Huron by 1.7 inches. To put this in perspective, artificial diversion *into* the Great Lakes presently exceeds diversion *out* of the Lakes by approximately 1,800 cfs. It therefore would appear that diversion by Illinois could be increased without having any critical effect on the Great Lakes Basin as a whole. Indeed, such an increase would allow a better inflow-outflow balance to be achieved.~~

SECTION C

Groundwater Mining

8.12 GENERAL There are two basic approaches to groundwater development. The first regards aquifers only as systems through which water moves, and favors limiting well withdrawals to the practical sustained yield. The second approach, mining, favors continued withdrawal of water from the aquifers at a rate which exceeds that of recharge. At the present time, approximately 96 MGD of the 142 MGD pumped from the deep sandstone aquifer in this region are mined.

8.13 ADVANTAGES AND DISADVANTAGES Mining is a debatable issue. The most common argument against the practice generally has been that since it removes water held in storage, it deprives future generations of the right to obtain adequate water at low cost. The extension of this reasoning is that present pumpage ought to be reduced to sustained yield, with any deficiencies to be made up through the development of alternative supplies, including remote surface sources. In this way, water held in aquifer storage would be kept in permanent trust for future use. The counter argument in favor of mining is that the water in storage is of no value unless it is used. In addition, mining allows large capital investments in surface water supply projects to be deferred to a later date. In the interim, changing technologies and alterations in water use patterns conceivably could reduce the need for importing large quantities of water.

One of the central objectives of water management is to provide adequate service with the maximum net benefit to all. Clearly, if the same benefits can be derived from any of several alternatives, the least cost alternative will result in the maximum net benefit. Since the cost of mining water is usually less than the cost of obtaining water from an outside source, it follows that mining may need to be conducted until it is no longer economically feasible, at which time the next "lower cost" source would be developed.

There are a number of other reasons why mining of the deep sandstone aquifer might be continued on a managed basis in northeastern Illinois. First, if mining were not practiced and withdrawals were limited to the rate of recharge, a number of townships in the region would become deficient in groundwater by 1980. Given existing legal limitations on diversion of Lake water, these deficiencies could not easily be satisfied by importation from that source. Furthermore, considering the existing investment in wells and pumping facilities, coupled with the large amount of water held in aquifer storage, it may be expedient to continue or accelerate mining, at least on a short-term basis. It should also be noted that the dewatering of the aquifer as a result of mining probably would not cause serious damage to the aquifer's water storage or transmitting properties. Indeed, if after a period of mining, pumpage were reduced to sustained yield, water levels would rise and the capacity of the aquifer to transmit water would eventually return to its original state.

APPENDIX G

Water Conservation, Recharge, and Recycling

8.14 GENERAL One means of helping to avert water shortages is to institute water conservation and/or reuse and recycling techniques. Conservation measures employ technical, economic, educational or legal tools to control water usage in such a way as to balance it with supply. Recycling seeks to maximize the use potential of any given quantity of water. The primary objective of both of these approaches is to manage existing sources more efficiently and effectively as an alternative to developing new sources.

8.15 WATER CONSERVATION TECHNIQUES A detailed discussion of water conservation (particularly domestic conservation techniques) is contained in Appendix E. That which follows is primarily concerned with water metering and leakage control with brief attention given to reduction of in-house water waste.

a. Metering Metering water consumption is one method of encouraging thrift and normalizing water demand in a community. Metering allows consumers to be charged according to the amount of water they use, thus providing an economic incentive to minimize waste. For example, greater use of meters has been cited as a contributing factor to the reduction in per capita consumption in the City of Chicago, where average water use decreased from 302 gpcpd in 1930 to 249 gpcpd in 1972.

Metering is regarded as one of the most fundamental precepts of modern water management. Yet, a number of public water systems in the region do not meter consumption and prefer to charge a flat rate for water provided regardless of the amount used. With a flat rate system in operation, there is virtually no economic incentive for consumers to practice water conservation.

It must be recognized that the cost of purchasing, installing, maintaining and reading water meters is substantial. Thus, it may not be economical to meter all water users that are presently unmetered, particularly in light of the relatively low rates charged for water in most communities. However, as water becomes a more valuable resource in the future, greater metering (at least of new and large users) will probably be practiced.

b. Control of Leaks Leakage from water distribution systems can create a substantial demand on water supplies without providing any corresponding benefits. Excessive leakage reduces the amount of water available for domestic purposes and increases overall costs. A number of factors influence leaks, including: age of the system; materials used in construction; physical and chemical properties of the soil; properties of the water; pressures involved; and the degree of proper maintenance.

While no system is absolutely tight and some leakage will inevitably occur, leaks should be reduced to the greatest practical degree. In the construction of new distribution facilities or in the replacement or addition to older facilities, leakage control can be achieved through proper sealing of joints and testing for tightness. Control in existing systems can be achieved through an ongoing detection and correction program. However, the savings derived from such a program must be balanced against the costs of its operation. Total elimination is seldom justifiable economically, but it can proceed to the point where the cost of salvageable water lost equals the cost of a repair program. Any additional rehabilitation beyond this point would not be economical since the cost of repair would exceed the incremental benefits derived from the water savings.

The appropriate magnitude of a leakage detection and repair program is thus dependent upon a number of factors, the most important of which are: the rate of loss of salvageable water within the system; the cost of supplying water; and the cost of system maintenance and repair. Individual communities contemplating a leakage control program should evaluate their particular systems in light of these conditions to determine the extent of corrective action warranted. Those having serious leakage problems may benefit considerably from increased water savings, especially if water costs are high or supply is inadequate. Conversely, communities that have relatively minor leakage problems, low water costs and abundant supplies probably need not undertake extensive control programs.

c. Water Conservation in the Home Several steps can be taken to reduce water consumption and/or waste in and around the home. Maintenance and repair of leaky plumbing fixtures can save large quantities of water over time which otherwise would be lost. Use of water conserving devices such as shallow trap toilets, washing machine "suds savers" and restricted flow showerheads can also reduce in-house water consumption. Substantial reductions can also be effected by taking care that lawns are not overwatered and that too much water is not used for such activities as washing automobiles. Conscious efforts to eliminate waste not only conserve water but also result in economic savings in the form of reduced water bills.

8.16 ARTIFICIAL RECHARGE Intensive development of groundwater has created considerable interest in the possibility of artificially recharging the aquifers. Replenishment of water in areas of concentrated pumpage, if feasible, would reduce the rate of water level decline and improve the yield capacity of wells. Consequently, the lives of existing wells could be prolonged and the aquifer could continue to provide a dependable water supply.

a. Sources of Recharge Water The most readily available source of water for artificial recharge is the seasonal high flow in surface streams. The diversion of high flows from stream channels for artificial recharge would also make available additional storage space in these channels for the temporary storage of flood peaks. Sophisticated stormwater drainage systems provide efficient means for the collection and temporary detention in basins of water that also can be used for artificial recharge of the shallow aquifers. If the highy polluted initial flush from urban areas is bypassed, the remaining stormwater, if treated, may be suitable for artificial recharge. However, the feasibility of this technique needs to be more thoroughly investigated. Other possible sources include cooling water, certain industrial wastewaters, and conceivably, treated domestic wastewater.

b. Methods The three principal methods of direct artificial recharge are water spreading, seepage pits and injection wells. Induced infiltration from streams caused by pumpage from nearby wells is an indirect method of artificial recharge. Whatever the method, artificial recharge requires agencies and facilities to: obtain, treat (if necessary) and transport the water to the recharge area; infiltrate or inject the water; and provide for the disposal of any excess water. The development of the area affects the capital costs of the project. High land costs in the urbanized parts of the region favor the use of the pit and injection well methods which require less land. Spreading basin methods require more land and would more likely be used in rural areas. Economics will strongly influence the degree to which artificial recharge operations are initiated in the future.

c. Potential Recharge Areas The Illinois State Water Survey has identified ten areas in northeastern Illinois which would probably be suitable for the pit method of artificial recharge. These areas were selected because: there was a well-defined cone of depression in the water level surface of the aquifer under consideration; there was a surficial sand and gravel deposit in the area; and there was a perennial stream in the immediate vicinity to serve as a source of water with which to recharge. The ten sites so identified are listed in Table 8-2, generally in order of decreasing need.

8.17 ENHANCEMENT OF NATURAL RECHARGE Management measures can also be taken to protect or enhance natural recharge. For example, in rural areas, natural recharge rates can be increased through the use of basic soil conservation techniques such as contour plowing and terracing. In urban areas (as well as in undeveloped rural areas) natural recharge can be sustained by restricting the construction of buildings, pavement and other impermeable surfaces in prime recharge areas. If these areas are reserved as open space and protected from intensive urbanization, they can continue to function in their recharge capacity. On the other hand, if they are substantially developed, recharge will not be able to keep pace with withdrawal and groundwater shortages may develop. Figure 8-1 depicts the prime natural recharge areas in the region.

TABLE 8-2: POTENTIAL ARTIFICIAL GROUNDWATER RECHARGE AREAS IN NORTHEASTERN ILLINOIS(14)

County	Potential Recharge Area	Recharge Source	Aquifer
Cook-Will	Park Forest-Chicago Heights	Thorn Creek	Dolomite
Will	Joliet (Hadley Valley)	Spring and Hickory Creeks	Sand and Gravel
Lake	Libertyville-Mundelein	Des Plaines River	Sand and Gravel Dolomite
DuPage-Cook	Western Springs-Hinsdale	Salt Creek	Sand and Gravel Dolomite
DuPage	Glen Ellyn-Lombard	East Branch of DuPage River	Sand and Gravel Dolomite
Cook	Wheeling	Des Plaines River	Sand and Gravel Dolomite
Kane	East Dundee-Carpentersville	Fox River	Sand and Gravel
Kane	Elgin-South Elgin	Fox River	Sand and Gravel
McHenry	Marengo	Kishwaukee River	Sand and Gravel
DuPage	Lisle-Downers Grove	East Branch of DuPage River	Sand and Gravel Dolomite

8.18 WASTEWATER RECYCLING AND REUSE Land disposal of wastewater has recently received a great deal of publicity and attention. In this approach, treated effluent is spread on the ground surface, usually with spray irrigation equipment. Nutrients are removed through vegetative uptake, and the effluent is further treated by filtration through the soil. Originally, it was intended that the water would continue to percolate through the soil and eventually become a part of the groundwater supply. However, pending more extensive investigations, concern for the protection of public health prohibits the use of such treated wastewater as a source of public water supply. Indeed, spray irrigation projects undertaken to date have employed underdrain systems to prevent pollution of the aquifers.

It also is not likely that large scale, direct recycling of wastewater effluent for use as public water supply will become a

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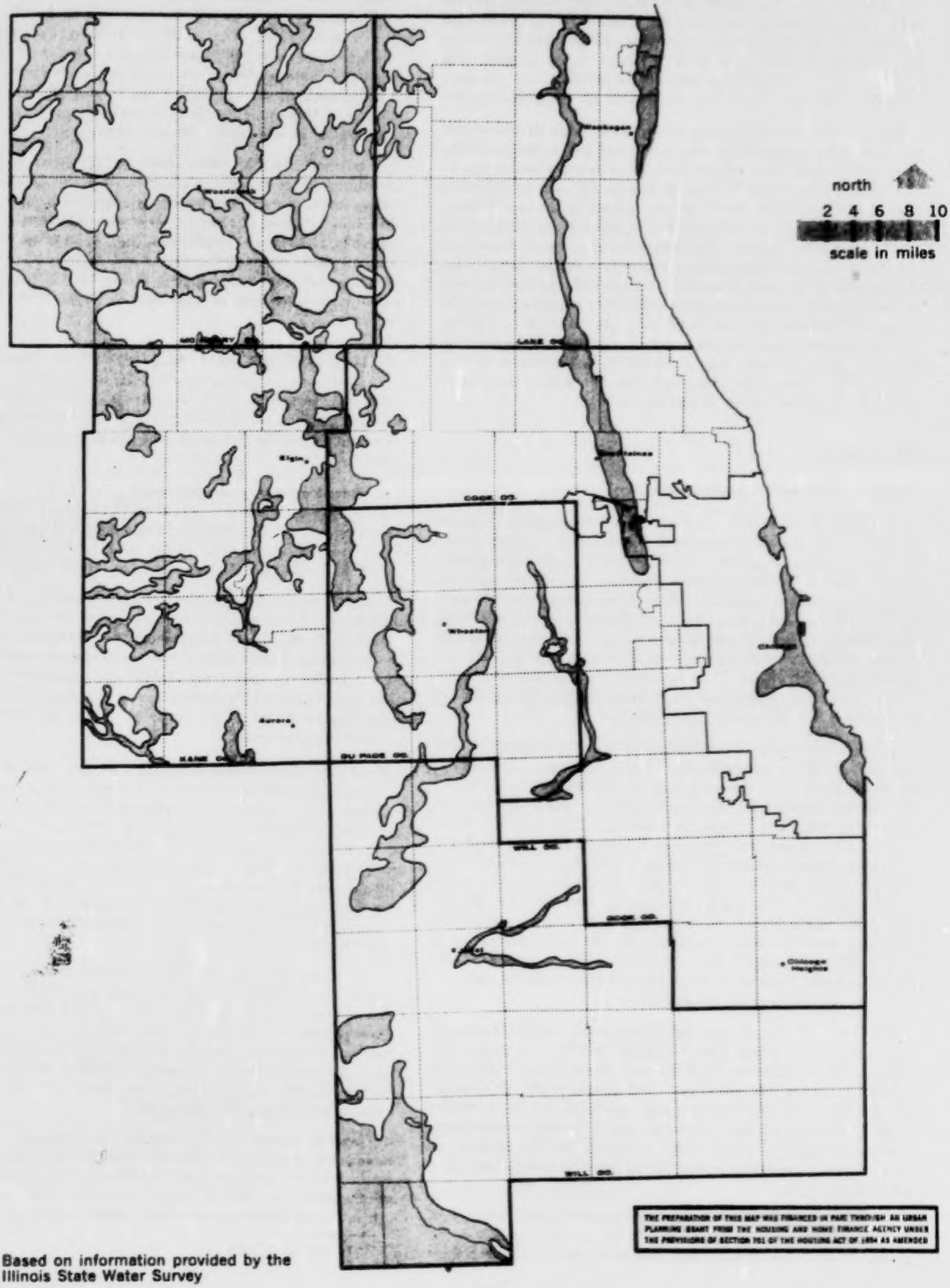
(14): Ref. 8

Figure 8-1 **Prime Natural Recharge Areas in Northeastern Illinois**


north
2 4 6 8 10
scale in miles
Woodstock
McHENRY CO.
Waukegan
LAKE CO.
Elgin
Des Plaines
COOK CO.
Wheaton
Aurora
KANE CO.
DU PAGE CO.
Chicago
WILL CO.
COOK CO.
Joliet
Chicago Heights
WILL CO.

THE PREPARATION OF THIS MAP WAS FINANCED IN PART THROUGH AN URBAN PLANNING GRANT FROM THE HOUSING AND HOME FINANCE AGENCY UNDER THE PROVISIONS OF SECTION 701 OF THE HOUSING ACT OF 1954 AS AMENDED

Based on information provided by the Illinois State Water Survey realistic alternative in northeastern Illinois, at least in the immediate future. It is true that sophisticated methods of waste treatment are presently available which allow near total reduction in the biological and chemical contaminants of wastewaters. When thus purified, the effluent is suitable for industrial or agricultural purposes. However, the cost of such treatment, when coupled with health concerns and probable aesthetic objections, does not presently favor the use of recycled wastewater for municipal supply.

During 1973, this Commission reviewed two separate but related applications for federal funds which involved testing the feasibility of recycling wastewater effluent for use as potable water supply. The applicants were the Village of Bensenville and the Hinsdale Sanitary District, both of which are located in eastern DuPage County where there is considerable concern for the adequacy of local groundwater supplies. The basic concept of both these proposed research and development projects involves the incineration of municipal solid waste to produce heat, which can then be used to distill treated wastewater plant effluent. Depending upon the outcome of test results, the distillate could be used to directly augment present water supplies or to increase local groundwater recharge. Both projects are presently being reviewed by the USEPA. Their futures are uncertain at this time due to the paucity of federal funds for projects of this nature.

SECTION E

Organization and Administration

8.19 FRAGMENTATION Perhaps the most conspicuous shortcoming of the present institutional framework for water supply is the extensive fragmentation of authority and responsibility. Several federal, multi-state, state, regional, and county agencies conduct specialized programs which have significance in water supply planning and management. At the local operational level, there are approximately 260 municipalities and numerous special purpose districts which are empowered to furnish water and engage in related activities. Then, too, there are a number of private utility companies authorized to provide water, principally in subdivisions and other unincorporated areas.

At the present time, this Commission is the only governmental unit conducting a comprehensive water resources management planning program in the six-county northeastern Illinois region. On the operational level, the trend continues toward the creation of more separate and independent systems which deal with problems on a piecemeal basis. Waterworks have been constructed and expanded without benefit of areawide planning, coordination or controls. Slight attention has been paid toward developing a water supply system for the region as a whole, with the view of providing for needs beyond the immediate future. Instances of coordinated, interlocal efforts have been few. Indeed, there are cases in which there has been keen competition between communities for available water, a situation which has at times interfered with the optimum development of the resource.

There are, of course, examples of successful intergovernmental cooperation. The arrangement by which the City of Chicago provides water to suburban Cook County communities is the most notable. Some of the lakeshore communities north of Chicago provide water to neighboring inland municipalities on a similar though more limited basis. There are also four public water commissions or districts which were organized for the purpose of obtaining and furnishing water to customer municipalities on a sub-regional scale.

The Great Lakes Basin Commission has noted that although it may be difficult, more emphasis should be put forth in developing plans for areawide utilities and cooperate efforts.(15) Problems such as well interference could be solved by preventing the proliferation of small water systems while favoring larger utilities which cross corporate boundaries and which develop the best available source of water rather than relying heavily on wells in the immediate area. The GLBC recommends that the preparation of such plans, before population pressures and increased water use necessitate independent crash programs, should begin immediately and be worked out with local, county and regional planning commissions. Implementing plans for areawide utilities may require the creation of additional laws and regulations.

The most pressing future water supply need will be that of providing adequate substitute sources for those areas of the region where groundwater deficiencies are expected to occur. Given the fact that the areas of projected shortage are generally located some distance from Lake Michigan, it is not feasible for individual municipalities to construct their own independent systems. Some type of multi-community approach may have to be taken in order to achieve economies of scale and to minimize conflicts and inefficiencies.

8.20 ORGANIZATIONAL ALTERNATIVES There are several alternative organizational structures which might be established for this purpose, varying both in scope of authority and area of jurisdiction. A number of these possible alternatives are highlighted below to illustrate the range of management opportunities available.

a. **Maintain Existing Arrangements** This is a continuance of the status quo in which no major changes in agency structures or prerogatives would be effected. Water supply development and use decisions would continue to be made at local levels, generally without regard for broader area needs and problems.

Water supply has traditionally been viewed as a local responsibility, and attempts to drastically alter this approach may not withstand the test of implementation. Therefore, expansion and coordination of the water supply programs of existing local units may be the most politically feasible and realistic method for dealing with water supply problems on a regional scale. The potential for duplication of effort, waste of funds, and competition and conflict would remain.

b. **Metropolitan Water Authority** At the opposite end of the institutional spectrum would be the creation of a six-county metropolitan water authority. If authorized, this agency would assume primary responsibility for furnishing water on a "wholesale" basis throughout the region, or for significant portions thereof where economies of scale might favor such an arrangement. Source development, treatment, and primary transmission would fall within its purview. Individual municipalities would retain responsibility for constructing and operating local distribution and storage systems.

It would also be possible to expand the role of the water authority to include other important aspects of water resources management. This has been done in the Detroit metropolitan area where a single agency was created to deal with the water supply, wastewater, and stormwater drainage problems of Detroit and 88 neighboring municipalities. With respect to water supply alone, significant cost savings have been realized as a result of the metropolitan utility approach.

Such an agency would allow for the systematic expansion and operation of all public water facilities in the region. It would of course be necessary to base such functional program on a comprehensive plan for the region to ensure orderly and efficient growth and development. Other issues requiring careful consid-

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APPENDIX H

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

O'HARE WRP

JUSTIFICATION FOR ULTIMATE SIZING

Justification for ultimate sizing of O'Hare WRP at 96 MGD is based on a rational evaluation of population forecasts made by Northeastern Illinois Planning Commission (NIPC) and MSDGC.

TABLE OF PROJECTED POPULATION & FLOWS

	NIPC Forecast		Original MSDGC Forecast	
Year	Pop. (1,000)	Flow (MGD)	Pop. (1,000)	Flow (MGD)
1970	223	36	223	32
1980	261	50	351	53
1990	277	62	419	67
2000	300	73	439	76
2010	315	77	439	81
2020	332	80	439	87
2030	350	83	439	92

The presently proposed O'Hare WRP was designed using population and flows originally forecasted by the MSDGC. According to this forecast, the O'Hare WRP was designed as a 72 MGD plant with a design year of 1988 and ultimate average dry weather flow of 96 MGD.

Since that time the MSDGC has agreed with IEPA to use the demographic forecasts developed by NIPC for facility planning purposes. Using this data, the design year for the 72 MGD plant has been extended to approximately, year 2000. However, in the opinion of the MSDGC, the ultimate sizing of O'Hare WRP will remain at 96 MGD in spite of the NIPC Population projection. This conclusion is based on the following considerations:

1. NIPC population forecast indicates continued increases beyond year 2030. This implies that flow will also continue to increase.

2. Demographic projections are in all cases based on subjective evaluation of present and historical data. Being subjective, it should be recognized that neither MSDGC's nor NIPC's population forecasts may be entirely correct.

3. Flow for year 2030, derived by using NIPC's population and MSDGC's per capita flow, is 83 MGD. If the MSDGC's original population projection is assigned to the same per capita flow, the year 2030 flow would be 104 MGD.

4. In the opinion of the MSDGC, a plant serving a growing area such as O'Hare Facility Area should be designed

conservatively within the limits of economic effectiveness.

5. The 72 MGD O'Hare WRP is designed on a modular concept, and presently consists of three 24 MGD modules. Thus, addition of one more module would result in a plant capacity of 96 MGD at ultimate condition. While it is possible to add less than 24 MGD capacity, the modular concept would then be partially destroyed. Interchangeability of equipment would not be possible and the unequal flows to the addition may result a more difficult plant operation.

In view of all considerations stated above it is firmly believed and recommended that the ultimate size of the O'Hare WRP be 96 MGD.

APPENDIX I

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

HEALTH ASPECTS OF SEWAGE TREATMENT FACILITIES

Research & Development Department
S. J. Sedita

January, 1975

I. INTRODUCTION

Nearly every city in the United States with a population of more than 2,500 has some type of sewage treatment facility. Such facilities vary from primary settling and lagooning only, to the most sophisticated secondary (biological) and tertiary (physico-chemical) treatments available.

The purpose of this survey is to review what is known about aerosols generated by sewage treatment plants from two points of view:

1. The aerosols themselves, their persistence and composition.
2. Public health implications associated with sewage treatment facilities.

The second topic will be discussed primarily with respect to wastewater treatment personnel. This emphasis is justified on the basis that such personnel represent the largest population in possible contact with these aerosols and should reflect any problems which might confront the general population upon exposure.

In reviewing we should attempt to answer two questions:

1. What specific health implications are associated with physical exposure to aerosols from sewage plants.
2. How valid are the assumptions concerning these implications?

II. SEWAGE PLANTS AS AEROSOL GENERATORS

Bacterial air pollution associated with sewage treatment plants has been investigated by Albrecht (1958), Higgins (1964), Randall and Ledbetter (1966), Kenline (1968), Adams and Spendlove (1970), Goff et al, (1973) and others.

From a review of the literature it may reasonably be concluded that microorganisms exist and persist in the sewage treatment process; and that the aerosols generated carry these organisms.

Aeration of sewage produces droplets by several mechanisms. The droplets evaporate to yield droplet nuclei (1-20 microns in diameter). Droplet nuclei generally contain a single bacterium (Kenline and Scarpino, 1972).

Once in the air, the organisms travel passively downwind. As they travel, their concentration (viable cells per unit volume of air) decreases due to several factors, e.g., atmospheric dispersion (Turner, 1967), deposition (removal from the air), and die-off (loss of viability).

Kenline and Scarpino (1972) modified Turner's (1967) dispersion equations to estimate atmospheric dispersion, and microbial populations at three sewage treatment plants in Ohio. An activated sludge plant in Hamilton, Ohio (12 million gal per day) and two extended aeration plants in Cincinnati (165,000 and 41,000 gallons per day, respectively) were the test facilities, and the study covered a period of 15 months.

In their study, Kenline and Scarpino (1972) estimated dispersion as a function of downwind distance, for an atmospheric stability of Class B and a wind speed of 2 meters/sec. The initial bacterial concentration was reduced by 50% at 15 feet downwind, and by 90% at 100 feet downwind. Kenline and Scarpino (1972) attributed this rapid reduction to the combined effects of deposition (independent of distance), diffusion and die-off (become more effective with increasing distance). In comparing extended aeration and activated sludge plants Kenline and Scarpino (1972) made the following points:

1. Extended aeration plants have a lower emission rate by 27%.
2. Aerosols from extended aeration plants have a 230% longer half-life than those from activated sludge plants.
3. The deposition rate is higher (380%) for extended aeration.
4. The combination of 2 and 3 above produced a bacterial cloud with essentially the same persistence at both types of facility.

Adams and Spendlove (1970) in a study of trickling filters, were able to show up to 98% reduction in coliform counts per cubic meter at distances of from 1320 to 4224 feet from the source. Kenline and Scarpino (1972) were also able to show that the vast majority of the total bacterial cloud belonged to families other than Enterobactericeae which accounted for only 5% of the total.

Adams and Spendlove (1970) and Goff et al (1973), were able to demonstrate the effects of sunlight and relative humidity on the survival of bacteria in aerosols from a trickling filter. Their data also indicate that coliforms make up from 0.3-24% of the total bacterial cloud depending upon the distance from the source.

The most obvious conclusions which may be drawn from these studies relate to survival of airborne bacteria and conditions which favor or preclude this survival, i.e.:

1. There is a rapid die-off of aerosolized bacteria (Adams and Spendlove, 1970; Randall and Ledbetter, 1966; Kenline and Scarpino, 1972).
2. Relative humidity shows almost no correlation with aerosolized bacterial survival (Randall and Ledbetter, 1966; Adams and Spendlove, 1970).
3. Sunlight kills bacteria trapped in aerosols (Adams and Spendlove, 1970; Goff et al, 1973).
4. The higher the wind velocity the farther entrapped bacteria travel (Goff et al, 1973; Adams and Spendlove, 1970).

5. The half-life of an aerosolized bacterium is approximately 13.8 seconds (Kenline and Scarpino, 1972).

III. HEALTH ASPECTS

Let us now examine the larger issue of the health implications associated with the generation of microbial aerosols. The major question to be answered is, "Are the assumptions concerning the implications valid?" Based purely on the experience associated with the construction and operation of activated sludge plants in the United States and the rest of the world since 1915, the answer must be no!

An obvious place to further explore this question would be to look at the health prospects of the population with the greatest exposure, namely, the wastewater industry worker. Several extensive surveys of this group have been carried out (Ander's, 1954; Browning and Gannon, 1963; California Water Pollution Control Board, 1965; Dixon and McCabe, 1964). The results of these studies lead one to conclude that workers in the wastewater industry are not exposed to any special danger because of the chemical and biological composition of sewage. With specific reference to infectious hepatitis, the Safety Committee of the California Water Pollution Control Board (1965) concluded that transmission of this disease by the usual means (personal contact or transfusion) was more likely even among this group (wastewater industry workers).

Considerable attention has been given to the studies of Randall and Ledbetter (1966), and Adams and Spendlove (1970), in arriving at the conclusion that a recognizable health hazard exists in the form of bacterial aerosols. The Randall and Ledbetter work was carried out at a maximum distance of 100 feet from the aeration basin of the plants studied, which is surely not a fair test of the exposure liability of individuals living at greater distances from the aerosol source. The Adams and Spendlove paper, on the other hand, purports to show significant coliform survival at distances of up to 0.8 miles (4224 ft.) from the aerosol source. In both samplings cited at 0.8 mi, the upwind control coliform count was 25% and 33% respectively of the downwind test sample. Further, with respect to the total bacterial count the upwind control at 0.8 mi was 71% of the upwind test sample, indicating that a significant proportion of the viable particles per cubic meter came from sources other than the waste treatment facility under consideration.

A consideration of the health aspects of aerosolized viruses and bacteria must necessarily include several factors, i.e.:

a) The concentration of ingested or respired viruses necessary to elicit symptoms in an individual.

b) The concentration of airborne viruses in the immediate environment of an individual.

c) Definable parameters that affect the survival of airborne viruses (presumably the same factors which affect bacterial survival in aerosols).

d) The degree of aerosolization associated with the activated sludge process.

e) The concentration of individual types of viruses in the wastewater being treated and aerosolized.

Although definitive information pertaining to all of the above factors does not exist, let us make an attempt to analyze some relevant aspects of each (Metcalf, et al, 1974).

It is recognized that as little as one tissue culture infective dose (TCID) of certain viruses may initiate infection in man. (Berg, 1971, states that, "a single plaque forming unit (PFU) of virus is capable of producing infection in man.") One must keep in mind, however, that the virus particle must come into contact with a susceptible cell (Plotkin and Katz, 1967). One must also realize that the ingestion of a single virus may not necessarily produce infection and probably does not in the majority of cases (see also letter to Mr. R. Ward from G. F. Mallison, Assistant Director Bacterial Diseases Division Bureau of Epidemiology, Center for Disease Control, Atlanta, Georgia). An examination of the variability of results in minimal infective dose studies indicates that there may be as much as a hundred-fold variation in data from study to study and with different enteroviruses (Plotkin and Katz, 1967).

Most of the studies on minimal infective dose such as those described above, were carried out using only one type of virus as total inoculum. Viruses encountered in the environment, whatever the source, generally include a somewhat heterogenous population (Metcalf, et al, 1974; Lamb, et al, 1964). It is, therefore, altogether possible that an individual ingesting or breathing more than one virus will ingest or breathe in more than one virus type. There is no evidence to suggest that this situation results in a greater risk of infection than ingesting or breathing more than one virus of the same type. On the contrary, experience with the Sabin strain of poliovirus types suggests that infection with more than one virus type may induce viral interference. (Davis et al, 1967)

One must also be aware, regarding the enteroviruses, that infection with a minimal dose does not normally result in perceivable symptoms. Polioviruses have been most extensively studied in this regard, and of the cases studied only one to two percent of persons exposed and infected exhibited frank symptoms of the disease. (Davis et al, 1967).

In a study of enteric viruses in activated sludge effluents, 52.6% of the isolates were identified as polioviruses. The population of the country is, on the whole, immunized against these viruses if they were non-vaccine strains. In addition, the remaining vaccine strains of poliovirus are non-virulent.

The majority of viruses that have been isolated from wastewater fall into three classification groups: picornaviruses, adenoviruses and reoviruses. Of the three groups picornaviruses (poliovirus , coxsackievirus , and echovirus) are most often isolated. Ingestion of picornaviruses very seldom results in anything more serious than transient infection of the alimentary tract, and reoviruses are, "questionable causes of respiratory tract disease " (Report of the Committee on Infectious Diseases, American Academy of Pediatrics, Evanston, Ill., 1974). The points made here apply equally to bacterial infections.

It is pertinent to this discussion to recognize that populations do not live in sterile environments and that microbes are everywhere. "One must be chary of the type of microbiological thinking that equates the mere presence of microbes with illness or the potential for illness. The fact is that illness is an unusually complex phenomenon that does not have a 1:1 relationship to microbes " (Benarde , 1973).

Returning, for a moment, to the question of "minimal infective dose," as posed in our previous discussion on viruses (and indirectly on bacteria) let us face a few facts. Reports appear in the literature from time to time indicating that one or another laboratory animal was given a specific disease. The range of numbers of organisms required to produce the illness may extend from a single cell (or virus particle) to several million. Additionally, the investigator very often has had to manipulate or stress the animal in order to produce "a take." The fact is that the combination of factors necessary to produce an illness is not known. "Among epidemiologists, it is widely accepted that it is even more difficult to start an epidemic than to try and stop one " (Benarde , 1973).

Addressing the problem of aerosol generation further, it is not difficult to appreciate the concern which public officials have for their constituency. They should not, however, create a problem where none is known to exist. It might be well to bear in mind the admonition of Dr. James W. Mosely, Chief, Hepatitis Unit, Epidemiology Branch, CDC to workers in the field of public health. His comments concerned the transmission of viral diseases by drinking water, but we feel that they are germaine to this discussion (Mosely, J. W., P. 5 in Berg, 1967).

"There are valid reasons for looking for new evidence. They are not, however, adequate substitutes for evidence. Our eagerness as public health workers to "do something" must not compromise the quality of data which we demand as scientists. We must also not confuse the possibilities which we entertain as scientists with the probabilities on which we base our recommendations as public health workers...."

Also relevant to our discussion is the concern expressed that the existence of the O'Hare Treatment Plant will be a nuisance and lower property values. Let us examine this question in the light of our experience at the Hanover plant.

The Hanover plant, admittedly much smaller than the proposed O'Hare facility, was constructed in an area relatively far removed from the population of the area. Now, however, residences abut the property line, children pass through the plant grounds on their way to school, and there is a park and playground on the other side of the fence surrounding the plant property.

The nuisances associated with sewage treatment facilities generally arise from odors associated with primary sludge treatment. The O'Hare facility is designed to be only a biological aeration facility. There is no generation of primary sludge for anaerobic digestion, nor will wasted secondary sludge be treated on site. On the contrary, it will be pumped via closed pipe to the new Salt Creek plant (John E. Egan Plant) for final treatment. Raw sewage will be pumped from a covered wet-well 100 ft. up to the aeration basin which should eliminate any odor problems. Also all grit, screenings and scum removed from the wastewater will be collected and temporarily stored in covered containers. Such operations will be performed in a temperature controlled room and the filled containers will be removed from the plant site on a routine basis (Letter to Mr. R. Ward from Bart T. Lynam, 1973).

Research

In as much as available data show that sewage treatment plant workers are healthier than workers in other industries, and that no documented evidence to the contrary exists, the District supports the position that more research is desirable to better define and evaluate the health implications of sewage treatment plant related aerosols.

Under USEPA Contract #68-02-1746 the Metropolitan Sanitary District of Greater Chicago is cooperating fully with the Southwest Research Institute of San Antonio, Texas in a study entitled "Health Implications of Sewage Treatment Facilities". The District has made the complete facilities of the John E. Egan Plant, Schaumburg, Illinois, available to the Southwest Research Institute for the conduct of this study. The objectives of this study are summarized as follows:

> "To determine whether or not there are any health hazards associated with the operation of activated sludge treatment plants. There are many new sewage plants under construction within the United States, and by necessity most are being sited in close proximity to populated areas. This project will collect information on the transport of bacterial and viral pathogens, parasites and trace metals from an activated sludge treatment plant (John E. Egan Plant, Schaumburg, Illinois) to persons living within a 5-km radius. There will also be a survey of the population near this plant before the plant is operational and during its operation to determine possible incidence of disease that may be associated with a sewage treatment plant. The information generated from this study will be used by the Environmental Protection Agency in its assessment of potential health effects associated with the operation of a sewage treatment facility."

In addition the District in cooperation with the Illinois Institute of Technology Research Institute, Life Sciences Research Division has submitted to the USEPA for funding a proposal entitled "Viral and Bacterial Levels Resulting from Land Application of Digested Sludge".

The objectives of this study include a comprehensive evaluation of the environmental effects of aerosols associated with the use of digested sewage sludges in agricultural production.

It is clear that the efforts demonstrated by the District to gather new information on the Health Implications of Sewage Treatment Activities completely contradicts the claims of others that the District is insensitive in this regard.

CONCLUSION

From the foregoing, it must be obvious that our two orginal questions can be answered fairly specifically: From our knowledge of aerosols, microbial survival, disease patterns experience and the available literature we can ascertain no direct evidence which indicates any significant risk through physical exposure to aerosols from sewage treatment facilities. Given the declining rate of communicable diseases in the U.S. (Benarde, 1973), the possibility of an aerosol associated health risk far outstrips the probability of its actual occurrence.

In more recent surveys conducted by Ledbetter, et al (1972, 1973), it was found that there are no significant health hazards for sewage plant workers. Absenteeism among sewage plant personnel was found to be lower than among all other occupational groups studied (J. L. Melnick in Berg 1967).

No greater incidence of disease would be found among sewage treatment plant workers, than is found in the general population including (by extrapolation) persons living in the area surrounding a plant.

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APPENDIX J

METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO
STATEMENT OF POSITION
ON ODOR ORIGINATING FROM
SEWAGE TREATMENT PLANTS

ODOR CONTROL

I. INTRODUCTION

One of the areas of pollution control that causes so much concern today is the possible odor problem. Although it "has the least potential to do harm to the environment", the public's reaction to this factor is so intense that it "can most quickly ruin a plant or a company's image in a community" (1). Many urban areas are faced with this situation. Because of increasing growth, i.e. urbanization, essential facilities, such as wastewater treatment plants, are being unavoidably located in proximity to residential areas. This, however, is causing vehement opposition from the public, notably because of an apparent odor potential. A need, therefore, has come to include in the design of wastewater treatment plants, facilities which would reduce--if not eliminate--odors to undetectable levels.

II. SOURCES OF ODORS

Occasional odors from a conventional wastewater treatment plant can usually be traced to the following sources: septic raw wastewater, screenings, grit and scum facilities, and sludge treatment facilities.

Odor producing substances in the raw sewage are generally products of anaerobic decomposition. Extended residence time in sewers causes the depletion of dissolved oxygen in the sewage thus creating an environment conducive to the growth and activity of facultative and anaerobic bacteria. The product of such an activity is a highly odorous gas, hydrogen sulfide (H_2S). Also present are such other odorous compounds as indol, skatol, mercaptans, disulfides, volatile fatty acids and ammonia. These compounds usually appear in the pump station wet well.

Screenings and grit consist of the larger solid materials which are physically removed from the raw sewage at the pretreatment stage. It is necessary to remove these materials in order to prevent interference with subsequent plant operations and wear and tear of plant equipment. Since the organic fraction of these materials can still undergo decomposition, they constitute a potential source of odors.

Scum accumulates on the water surfaces of the sedimentation tanks, and is collected by skimming devices. Like the grit and screenings, the scum also constitutes a potential source of odors. Proper scum handling is essential in order not to create an unpleasant atmosphere for the plant personnel and neighboring population.

Sludge is the solids by-product of wastewater treatment plant processes. It is composed largely of the substances responsible for the offensive character of the septic sewage. Sludge characteristics depend on its origin, the amount of aging that has taken place, and the type of processing to which it has been subjected. In a conventional biological treatment plant, the sludge sources are the primary sedimentation tanks and the final settling tanks. Aged primary sludge has an offensive odor while the waste activated sludge, under favorable conditions, has an inoffensive characteristic odor. Most odor complaints are caused by improper operation of the sludge handling facilities which include thickening, digestion, dewatering and drying, and disposal.

III. ODOR CONTROL TECHNOLOGY

The literature and proven experience present several basic means of odor control. They are ventilation, adsorption, washing and scrubbing, chemical oxidation, counteraction (masking or neutralizatio and combustion.(2) Although these methods can all be capably employed to control odors, their effective applications require recognition of the source, the nature of the odors and the degree of abatement required. In a conventional wastewater treatment plant, the selection of the odor control method requires familiarity with the operational treatment procedures and the potential sources of the odors. In fact most of the methods available for odor control are presented in the USEPA's Technology Transfer Series.(3) The odor control methods are summarized in the following sections.

1. Changes in Operational Procedures and New Techniques

Inadequate plant design which results in overloading of the treatment processes, such as sludge concentration tanks, anaerobic digesters, etc., can cause odor problems. Plant modifications, such as improved temperature control and efficient mixing of digester contents as well as the observance of good housekeeping practices can contribute to the elimination of unwanted odors.

2. Chemical Treatment

Most odors in wastewater can be destroyed by oxidizing the substances that produce them. Chlorine and ozone are two commonly used oxidizing agents in waste treatment. Both serve to accomplish the same purposes: to retard biological action which produces odors and to react chemically with odorous sulfur compounds, oxidizing them to relatively inert and inoffensive sulfur forms. Ozone has extremely high reactivity but because of its high cost, its use is limited. Chlorination is most commonly employed with the use of the liquid chlorine or sodium hypochlorite.

Other, but less common, odor control agents used in wastewater treatment are lime and powdered carbon. Lime decreases the odor level by raising the pH of the septic sewage thereby minimizing the amount of H_2S evolved. Consideration should, however, be given to the increase in sludge production as a result of lime addition. The significant adsorptive characteristi of powdered activated carbons is very useful in reducing the odor level. Tests show that a concentration of less than 10 mg/l of powdered activated carbon was successful in reducing odors.

3. Collection and Treatment of Noxious Gases

This method involves the covering of unit process facilities that are potential sources of odors and to prevent odors from reaching the atmosphere. Besides the enclosing structure, the technique requires collection and treatment facilities for the noxious gases prior to their release. Also required is a ventilating system to avoid a high humidity and possible formation of indoor fog, and to provide a trouble-free environment for plant personnel.

The treatment methods usually employed for evacuated gases include combustion, ozonation and chemical oxidation.

Most odorous gases are combustible and can be destroyed by complete oxidation. Simple combustion method requires heating the gases to a temperature of approximately 1300°F to 1400°F. Consideration should be observed to avoid incomplete combustion which may aggravate an odor problem. Cost associated with this method is usually dominated by its high fuel requirement.

Ozone is a powerful oxidizing gas that quickly oxidizes volatile odor producing inorganic and organic compounds such as hydrogen sulfide, indol, skatol and mercaptans. In inorganic reactions only one atom of ozone usually enters the reaction producing the final oxidized state of the compound and O_2. In organic reactions it may behave similarly in utilizing only one atom of its molecule, but usually the reaction proceeds to form an ozonide wherein all the ozone is completely coupled with the organic compound. Such reactions are complicated and are affected by such parameters as accumulation of reaction products, moisture, temperature, etc.

The ozone generation process involves the passage of dry air between electrodes across which an alternating high-voltage potential is maintained. To insure optimum conversion of oxygen to ozone, a uniform blue-violet glow discharge is maintained throughout the gas. The glow discharge is created by inserting a dielectric material between the electrodes which causes the glow to spread uniformly and prevents breakdown into brush and arc discharges.

Catalytic combustion oxidizes odorous air at temperatures 500 to 800°F lower than required by simple combustion.(4) Its advantage over ordinary combustion is the considerable lowering of the firing temperature, with a resultant saving of energy for heating air, and capital equipment costs for heating capacity.

ODOR CONTROL AT THE O'HARE WRP

One of the major issues expressed by local residents against the construction of the O'Hare WRP is the potential odor problem. People are instinctively opposed to construction of facilities which may at times result in possible odor nuisance. While this can be naturally understood, it is worthwhile to note that the MSDGC, cognizant of its prime obligation to promote a healthful environment within its jurisdiction, is employing techniques which have been proved to be effective in the elimination of the potential pollutants.

The design of this proposed facility incorporates several modification of the conventional wastewater plant to either eliminate an odor sourc or control potential odor sources. As a result of an economic study sludge will be pumped and piped to the John Egan WRP for treatment and handling. This eliminates the sludge thickening, digestion, and handling facilities which are principal sources of possible odors.

1. Potential Sources of Odors at the O'Hare WRP

The only potential sources of odors at the O'Hare facility will be the following locations:

a. Raw sewage pump station wet well
b. Screenings and grit storage area
c. Scum handling area

2. Methods of Odor Control at the O'Hare WRP

The most effective method of odor control is to prevent the escape of the pollutant to the atmosphere. This is economically accomplished by eliminating the odor at its source or collecting the odor producing substance and treating it prior to its release to the atmosphere. The O'Hare WRP has been provided with the following facilities to achieve the above objective.

a. Pre-Chlorination. A pre-chlorination facility has been provided to chlorinate the raw sewage as it enters the treatment processes. This accomplishes both odor control and increased treatment efficiency. Chlorine reacts with the odor-producing substances such as H_2S and other sulfur compounds through oxidation which results in chemical compounds devoid of any unpleasant odor.(3) As a disinfectant it kills odor-producing bacteria relieving subsequent treatment units such as the primary and secondary facilities from emitting the noxious gases. Pre-chlorination also inhibits the corrosive characteristics of the raw sewage, thereby reducing its detrimental effect on the metallic components of the facility and helps promote consistent plant efficiency.

Chlorination will be accomplished utilizing a commercial sodium hypochlorite solution. Since the MSDGC has a vast experience in this process, the efficient and safe operation of this facility need not be further discussed.

b. Ozonation. The proposed treatment plant will contain two packaged ozone generating units. One unit will be on-line and the other unit will be on standby.

The units are designed to treat exhaust air from the pump station wet well and from the screenings, grit and scum areas. The units will be complete with reaction chamber, transformers, variable voltage controls, compressor air filter, motors, air cooler, air dryer, interconnecting piping, ozone supply piping, ozone diffusers and controls.

Each unit is designed to treat a maximum of 94,000 CFM of exhaust air. The ozone generator will be capable of operating with a pressure range of 12 to 15 psig pressure and producing a minimum of 31.5 pounds of ozone, at 1% concentration, per day. This represents an ozone dosage of approximately 1.75 ppm (volumetric) which is within the recommended dosage range of 1 to 2 ppm (volumetric) for effective odor treatment.(5)

The ozonation system has also been designed so that ozone concentration in the discharged air will always be zero. Electronic monitoring and control equipment will be installed to detect and control emission quality. The ozonated exhaust system will be equipped with an ozone sensor at the discharge. If the ozone concentration of the exhaust air exceeds zero level (above the minimum detectable limits of the sensor), the ozone generator is manually adjusted to reduce ozone production. In this way, ozone concentration is continuously kept below TOL (Threshold Odor Level, the level at which its odors can be detected), 0.01 to 0.02 ppm (volumetric). (The IPCB rules regarding ozone state that "ozone watch" must be called when the average ozone concentrations exceeds 0.07 ppm for two hours and the official weather forecast indicates no substantial improvement in stagnation conditions.)

c. Isolation of Odors. Screenings, grit and scum will be collected in such methods as to prevent the leakage of the noxious gases emanating from them into the atmosphere. They will be separately enclosed in areas which will be temperature controlled to inhibit formation of odors. Exhaust air from these areas will be conducted to the ozonation chamber to insure complete deodorization. The MSDGC has also adopted containerization methods wherein these materials are placed in containers and disposed off the plant premises daily by private scavenging contractors.

V. CONCLUSION

The satisfactory performance of a properly designed wastewater treatment plant is hinged on the reliability of back-up facilities to sustain the system at its design capacity at all times. Observations indicate that odor problems, if at all, occur during plant overloading or bypassing of essential treatment processes resulting from mechanical difficulties and unreliable standby facilities. Indifferent maintenance and operation management may also supplement or aggravate the problem.

The plants cited by some witnesses at the Public Hearing held on December 19, 1974, have experienced at least one of the above difficulties to cause an odor problem. Although the existing MSDGC's North Side and Hanover Park plants do not have odor control facilities, such as proposed at the O'Hare WRP, good housekeeping and improved treatment processes have afforded an almost completely odor free atmosphere in spite of frequent overloading prior to the construction of the 4 MGD Addition at Hanover and existence of sludge concentration facilities at North Side. The O'Hare Water Reclamation Plant does have adequate back up facilities to handle overloading and does not have sludge concentration facilities.

The treatment plant at the City of Lodi, California apparently treats and handles its sludge and does not appear to have odor control facilities. The Sacramento Plant employs trickling filters and has a peculiar problem of treating seasonal canning waste. It will be noted that odor problems have occurred during the canning season which overloaded the plant. After the plant expansion and the introduction of odor controls, performance proved that "sewage treatment plants can now be built closer to residential areas"(6). The Clavey Road Plant was severely overloaded for many years prior to the time when residents demanded relief from odors and irritating emissions. Process failures under overloaded conditions would produce significantly greater problems than a failure under design conditions.

In addition to the proposed odor control facilities at the O'Hare WRP, it is to be emphasized that the MSDGC has a strict policy of adhering to the rules of good housekeeping. The awareness of the inherent responsibility of the District in promoting a climate conducive to better living and clean environment can be traced back to the long standing record of the District. This record will be maintained in the future years.

References:

1. Herr, G.A., "Odor Destruction-A Case History", presented at 66th Annual AICHE Meeting, Nov. 13, 1973, Philadelphia, Pa.

2. ASHRAE Handbook of Fundamentals

3. Roy F. Weston, Inc., "Process Design Manual for Upgrading Existing Wastewater Treatment Plants", EPA Technology Transfer, Oct. 1971.

4. Guide and Data Book, ASHRAE

5. Ozonation in Sewage Treatment, University of Wisconsin, Nov. 9-10, 1971, p. 20.

6. E. Herr & R. L. Potorak, "Program Goal - No Plant Odors," Water and Sewage Works, Oct. 1974.

APPENDIX K

NICHOLAS J. MELAS
PRESIDENT

THE
METROPOLITAN SANITARY DISTRICT
OF GREATER CHICAGO
100 EAST ERIE ST., CHICAGO, ILLINOIS 60611 . . . 751-5600

Bart T. Lynam
General Superintendent
751-5722

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February 11, 1975

ENVIRONMENTAL PROTECTION AGENCY
RECEIVED

PLANNING BRANCH - Region V
FILE NO. GN-1.j.2.3.

Mr. Francis T. Mayo
Regional Director
Region V
United States Environmental
Protection Agency
230 South Dearborn Street
Chicago, Illinois 60604

Subject: Environmental Impact Statement
O'Hare Water Reclamation Plant

Dear Mr. Mayo:

During the past several weeks, the District has generated and submitted to the Region V office, position papers related to the general areas of comment received at the Public Hearing held in December for this project. These papers cover the general topics of odors, site selection, the O'Hare Basin Plan, and health aspects of wastewater treatment plants.

Based on an analysis of the submittals on the draft statement, the question of potential health hazards associated with aerosol generation was the primary concern of the individuals who participated. Many arguments were made for eliminating this potential. These included plant relocation, covering of the plant process areas, and abandonment of the O'Hare Basin Plan (for which a number of alternates were presented).

Representatives of the public presented a large number of references which cited the potential for aerosols to serve as a vector for disease transmission. There is, however, an obvious lack of case histories or documentation which would indicate that any hazard has ever actually occurred. As noted in our position paper on the health aspects, there is no recorded incident of disease associated with the operations of a well-managed wastewater treatment facility.

In today's world of almost instantaneous communication, epidemiological outbreaks of disease associated with these operations-presented as being of great concern to the public-would be easily found. This has not been the case. Those studies associated with occupational health hazards for treatment plant operators have failed to indicate any evidence that the potential so frequently referred to has been realized.

As you are aware, intensified research related to this particular potential has been initiated. Many studies are being conducted nationally to evaluate the degree of remedial and future actions, if any, related to this potential. The District, whose primary responsibility is to safeguard the health of its constituents, is participating in some of the research projects and will closely follow the progress and results of such programs. If it is determined that modifications, to any degree, are required for the District's facilities, the District on its own initiative would expedite the necessary actions.

In the meantime, the District will maintain its high standards of maintenance and operation of facilities in order to prevent development of situations which could cause the public concern. In addition, the District is evaluating methodology for reducing aerosol transmission from the plant proper.

During the construction period of the O'Hare Water Reclamation Plant, it is anticipated that a large amount of information related to this problem will be generated. This information will relate not only to cause and effect, but the parameters upon which technology for addressing the question would be based. It is expected that a period of three years would give adequate time for the development of this information. If the results of the information gathering projects indicate the need for some level of aerosol containment, retrofitting of the O'Hare Plant could be accomplished prior to startup. The information gained would permit determination of a cost-effective solution with a high degree of reliability. It could reach $30 million for this facility. In view of the lack of any empirical indication that a health hazard potential has been realized, it is obviously prudent to evaluate the conjecture in a professional manner prior to imposing requirements which are unneeded or could be ineffective.

The second largest area of concern appears to be the question of odors. The major case cited, the Clavey Road Plant, presented an obvious case for public concern. It must be categorically stated that the proper operation and maintenance of a wastewater treatment facility, which was properly designed to handle the imposed load and is treating the type of wastes associated with wastewater in the Metropolitan Chicago Area, does not present an odor concern for the public. The degree of sophisticated instrumentation for the operational control incorporated into the design of the O'Hare Plant assures, to the greatest degree possible, that upsets associated with mechanical or operational failures will not be a matter of concern. The degree of insurance against all possibilities requested by some members of the public is without precedent in our society. The District, in its design of the facility, feels that the highest degree of reliability is provided. Our society cannot afford to expend huge sums of money to prevent a potential temporary inconvenience which may occur a few times during the life of the facility.

A third area of concern was the emission of materials from treatment plant processes which could be considered air polluting substances. This concern was expressed in the context of potential cumulative or synergistic effects when the level of pollutants resulting from the activities associated with O'Hare Airport were at or above accepted levels. Basically, the District has indicated that the only significant emission of this type is carbon monoxide (CO_2). Based on an air feed to the system of 26 million pounds per day, the CO_2 exhausted would amount to 25,400 pounds per day or less than 1/10 of 1% of the total exhausted. It is somewhat incongruous that the District must respond to concerns associated with emissions from aircraft operations. Additionally, the impact on real estate values is far more a function of proximity to the O'Hare Airport than any impact the proposed water reclamation plant may have. It is curious that, to our knowledge, the City of Des Plaines has neither passed regulatory ordinances nor filed lawsuits against the activities at O'Hare International Airport, which is claimed to have such a harmful effect on the Des Plaines environment.

In general, the District has not attempted to answer each individual question submitted in connection with the Public Hearing on the draft statement. Rather, the District has chosen, through the use of position papers, to respond to those major areas of concern expressed. The District's major responsibility is safeguarding the health of the citizens it serves. The District has made and will make every effort-in a reasonable and rational manner-to fulfill this responsibility. The location and design of this facility are well within the limits for providing safeguards for the residents of the area.

Very truly yours,

Bart T. Lynam

Bart T. Lynam
General Superintendent

APPENDIX L

1. Land Treatment Alternative

The MSDGC modeled their land treatment alternative after the conceptualized system described in the "Wastewater Management Study for Chicago - South End of Lake Michigan" (C-SELM) prepared by the Chicago District Corps of Engineers. MSDGC evaluated the alternative for a design year of 1990 assuming a total flow of 2118 MGD and a service population of 5,770,000.

a. Objectives

The primary objective of any wastewater management system is to economically remove waste constituents from all wastewaters in an environmentally acceptable way.

Proponents of the Land Treatment system anticipate the following treatment performance:

Constituents	Effluent Concentration (mg/1)
COD	6
BOD 5 day	2
Suspended Solids	0
Dissolved Solids	500
Soluble Phosphorus	0.01
Ammonia NH_4	0
Nitrate & Nitrite	2
Organic N	0
Heat - Temp. (F)	53-78

Constituents	Effluent Concentration (mg/l)
Oils	0
Phenols	0
Pathogens, Virus	Absent
Trace Metals	0
Boron	0.7
Arsenic	0
Cyanide	0

Absent or zero (0) means not detectable by standard testing methods and current technology.

Inspection of the wastewater qualities for the C-SELM area and the MSDGC service area indicate that the characteristics of the two sources are very similar. Therefore, it was concluded by the C-SELM that the MSDGC flows could be treated without adjusting for differences in wastewater characteristics.

b. Brief Description of Land Treatment System

1) Treatment System

This system includes the wastewater lift stations which convey wastewater from land conveyance tunnels to degritting facilities and biological treatment lagoons. The effluent from these aerated lagoons is then discharged to storage facilities when irrigation of the wastewater is not feasible. The storage lagoon water is chlorinated prior to irrigation on the land at controlled rates to coincide with the critical nutrient requirements of agricultural crops during the growing season. Following advanced treatment provided by the soil medium, the percolated water is collected by a drainage system for conveyance and returned by reuse tunnels to the MSDGC Service Area.

2) Sludge Management System

The treatment of MSDGC wastewater results in two end-products: the treated effluent and the solids, or sludge, removed during treatment. The treatment and disposal of sludge is a major design consideration of this wastewater management study.

The problem of dealing with the sludge is complicated. The solids content of sludge represents only a small percentage of its total weight, with the rest being water, both cell tissue water and supernatant water.

Land treatment sludges would have a high concentration of decomposable organic matter. Sludge is ex expected to be 6.0% total solids by weight with the balance being water. Approximately 0.77 dry tons of digested sludge would be produced per million gallons of sewage treated. This yield figure includes grit.

Ultimate disposal of sludge generated as a by-product of sewage treatment is accomplished by application of sludge considered for the MSDGC system is land reclamation.

The land reclamation approach assumes the application of biological sludges to strip-mined areas in Illinois at a controlled rate during a short period of time.

In the land treatment system, the solid wastes are conveyed with the wastewater to the land treatment sites where, after biological treatment, they are stabilized by anaerobic digestion on the bottom of the land treatment storage lagoons. After a period of years, the digested sludge is dredged from the bottom of the lagoon and transported to land reclamation sites.

c. Land Treatment Process

1) Aerated Lagoons

It is proposed that the wastewater first be degritted then treated in the aeration lagoons. The land treatment modular design is based on provisions for a 5000-acre surface water storage lagoon to handle a 265-mgd average daily wastewater flow, and to provide organic removals equivalent to secondary treatment in a detention time of three days based on the 265 MGD average daily flow. The working water depth in these lagoons is 15 feet and the total area required, including berms, is about 200 acres. The total earthwork necessary to construct a three-celled lagoon for the modular design exceeds three million cubic yards. Aeration is provided by low-speed surface mechanical aerator-mixers.

2) Storage Lagoons

The aerated lagoon effluent is conveyed by gravity flow to the storage facilities to provide solids separation and storage of wastewater when irrigation is not feasible due to wet or freezing weather conditions.

They are designed for a four-month storage capacity at 265 MGD, or a total volume of nearly 33 billion gallons of wastewater. An average water depth of of 20 feet makes necessary a total surface area, including berms, of 5,400 acres. A three-foot dead storage volume is provided for solids accumulation prior to sludge utilization. The estimated in-place earthwork requirements for the construction of the storage berms is 12 million cubic yards. The water discharged from the storage lagoon would be chlorinated prior to land application, requiring facilities with a capacity of 615 MGD or a peak chemical demand exceeding ten tons per day, at a dosage of 4 mg/l.

3) Irrigation Facilities

Upon completion of chlorination, the lagoon effluent is pumped to the irrigation lands for application to the soil. The irrigation facilities consist of pumping stations and a force main transmission network to convey the water to irrigation machines for application to the land. The irrigation system results in a land utilization factor in the range of 35 to 60 percent by minimizing disruptions to the present land use. For the modular 265 MGD design, an irrigation land utilization factor of 40 percent is used; thus, 2.5 acres of land are required to provide an acre of irrigated land.

4) Drainage System

After passage through the soil, the reclaimed water is collected in a drainage network of pipes and channels to central access points for discharge to a recalaimed water tunnel system and subsequent transmission back to the receiving streams. The drainage capacity is equal to the irrigation application rate of 6 inches/week or the equivalent 615 MGD for the modular site. The basic drainage criterion is the maintenance of a minimum aerobic soil zone five feet deep to facilitate the chemical, physical and biological soil treatment processes so that effluent standards may be attained. Thus, prolonged saturation and increased salt content of the soils and resultant crop losses are eliminated.

5) Effluent Characteristics

The Land Treatment Alternative is expected to produce an effluent equivalent to that produced by an advanced level of treatment. The equivalent of primary and secondary treatment is first provided by the aeration and storage lagoons, while land application utilizing the biosystem of both the soil and the cover crops will produce renovated water suitable for almost all uses.

6) Sludge Treatment

Land treatment of wastewater produces two end-products, the treated effluent and the solids, or sludge, removed during treatment. The latter is a biological or organic sludge with a high concentration of decomposable organic matter that could produce offensive odors if allowed to decompose in an unregulated manner. To prevent this, anaerobic digestion is used to stabilize the organic matter. This sludge is expected to be 6 percent total solids by weight. The process is expected to produce 0.77 dry tons of anerobically digested sludge per million gallons of sewage. As the soil in the strip-mined areas contains only limited amounts of organic matter or humus, the application of sludge serves to increase the humus content and the fertility of the soil, stimulating the growth of grass or trees for recreational uses.

d. Land Treatment System - Cost Estimate

The cost estimate for the MSDGC's Land Treatment Alternative is modeled after the cost methodology used in the C-SELM Report. Thus, where applicable, unit process and component cost developed in the C-SELM Report are used to estimate the cost of an equivalent system for the MSDGC's Land Treatment Alternative.

In order to make the economic comparison of the various treatment alternatives valid, all unit costs derived in the C-SELM Report are adjusted by a factor of 1.3. The resulting adjustments reflect the 1975 costs based on an ENR Construction Cost Index (CCI) of 2400.

The capital costs of treatment processes included all associated construction, field engineering, design, legal, administrative and contingency costs, but do not include land or sludge disposal costs. These cost factors are treated independently.

A summary of the costs for the Land Treatment Alternative are given in Tables L-1 and L-2. More detailed costs for the system components are presented on pages L-21 - 40.

Table L-1

SUMMARY OF CAPITAL, REPLACEMENT AND ANNUAL COSTS:

Item	Cost ($Million) Construction	Present Worth	Annual
Lift Station & Grit Removal	172	164	16.42
Aerated Lagoon	155	143	14.59
Storage Facilities	303	222	22.64
Irrigation System	775	598	61.00
Drainage System	429	416	42.40
Misc. Land System	120	75	7.7
	1,954	1,618	164.75

Capital Present Worth = $1,618 Million

Capital & Replacement - Annual = $164.75 Million

Table L-2

SUMMARY OF LAND TREATMENT SYSTEM COST ESTIMATE ($MILLIONS)

	Present Worth			Annual		
	CAP.	M & O	Total	CAP.	M & O	Total
Treatment	$1618	$1525	$3143	$165	$156	$321
Land	382	--	382	39	--	39
Sludge Mngmt	101	72	173	10	7	17
Conveyance	355	30	385	36	3	39
Reuse Convey	410	591	1001	42	60	102
Res. Soil & Rock Mngmt.	--	48	48	--	5	5
Total	$2866	$2266	$5132	$292	$231	$523

e. Environmental Impacts

The major impact of the Land Treatment Alternative would be on the water quality of the region. Within the area of the plan, there would be a measurable increase in dissolved oxygen. Phosphorus and nitrogen discharges from municipal and industrial sources would be reduced by 99 percent and, from the first 2.5 - 2.85 inches of storm water runoff, by 97 percent, thereby reducing the potential for algal blooms. The plan would also provide enhanced instream recreational usage including fishing and an improved flow regimen.

Possible beneficial effects of the plan on aquatic life and wildlife are relatively minor, and, therefore, cannot influence any decision based on environmental impacts.

C-SELM Study (G-XIII-29, and Tables B-VII-B-1 and B-VII-B-2) gives the following summary of chemical and primary energy requirements and secondary energy requirements (energy required to manufacture chlorine used) for the land treatment system:

Resources	
Chemicals	
Chlorine (lb/MG)	33
Primary Energy	
Electrical (1000 BTU/MG)	22,400
Fuel (1000 BTU/MG)	100
Secondary Energy	
Electrical (1000 BTU/MG	180
Natural Gas (1000 BTU/MG)	(9,590)
Crop Drying (gas)	1,000

However, an electrical requirement of about 25 percent (5,600 BTU) must be added for conveyance, storm water management and reuse systems. At 3414 BTU/KWH, the electrical requirements will equal 8254 KWH/MG. At an estimated flow in 1990 of 2,118 MGD for the MSDGC, the District's share of the cost of electricity, at 0.025/KWH, would be $451,000/day. This would represent an appreciable impact on the electricity generating capacity of the area.

The natural gas credit is given on the basis that the agricultural use of nitrogen fertilizer, which required the consumption of a natural gas-equivalent fuel, is relieved to the extent of the nitrogen applied by the sludge utilization and wastewater irrigation programs. On the other hand, consideration should be given to the fact that if reclamation of strip-mine land is part of the program, the nitrogen demands of reclamation are also one of the costs of the program. Although it is proper to give a natural gas credit for the agricultural program on cultivated land, since normal cultivation would require nitrogen fertilizer, a credit for the reclamation program is doubtful. Reclamation itself should be the only credit.

The major impact on resources will be on agricultural land. To carry out the MSDGC's share of the program, it will require the acquisition or leasing of a minimum of enough land to construct 8.07 treatment modules (2118 MGD/265 MGD per module). A module would have the following approximate area:

Aeration lagoons, acres	200
Storage lagoons, acres	5,400
Irrigated land, acres	66,000
Total acres	71,600

Therefore, the needs of the MSDGC would require a total of 71,600 x 8.07 = 577,800 acres of agricultural land. This does not include the land requirements for sludge disposal, since the latter would be carried out only on strip-mine land. At 1350 dry tons of sludge per day, accepting the figure given in the C-SELM Study of an application rate of 100 dry tons per acre, the land requirement would be 13.5 acres/day, or 4928 acres per year.

f. Institutional Aspects

In a November 15, 1973 letter from this Agency to Colonel James M. Miller, District Engineer, U.S. Army

Engineer District, Chicago we pointed out the major impediment in the way of the Land Treatment Alternative. Briefly, there is no known method of implementation, certainly none that would meet the necessary time schedule imposed by PL92-500 or by Illinois law. Quoting the above letter, "the institutional arrangements in effect in the area probably offer more nearly insuperable obstructions to the achievement of effective urban management than the technical difficulties". Also, "... a project of (this) magnitude utilizing primarily good quality farm land does not appear justifiable at this time". Again, "the public hearings also emphasized the need to seriously address the wisdom of converting a significant portion of the nation's agricultural lands into a restricted land use". Finally, "the apparently most economical alternative ... that this study promotes has not been shown to be environmentally sound or socially acceptable".

The MSDGC does not have the power of eminent domain outside of its own area. The Land Treatment Alternative indicates that it would be necessary to purchase 17,200 acres additional (C-SELM Study, Summary Report, Table VII-3). The experience of the MSDGC indicates that it would be most difficult, probably impossible, to buy or lease land to the extent necessary to establish such a program.

Without regard to any other considerations, the institutional objections to the Land Treatment Alternative would appear to rule out its implementation at any time in the foreseeable future.

2. RE-USE

a. Groundwater Recharge

The effluent from the O'Hare Plant may be of acceptable quality for recharging underground aquifers, however such recharging is not practicable under the present state of the art.

The deep sandstone aquifers lie from 1,400 to 1,900 feet below the surface, and are overlain with many hundreds of feet of impervious strata. The coefficients of transmissibility of the sandstone are so low that only small amounts of water could be forced into the aquifer.

Any attempt to recharge the shallow dolomitic aquifer would probably fail because of the impervious nature of the rock itself, and the uncertain nature and continuity of the crevices and solution channels.

b. Surface Water Supply Enhancement

There are no known users of surface waters in the O'Hare drainage basin. There are no known water-producing glacial sand and gravel deposits in the basin.

c. Recreational Use

Water quality in Higgins Creek will be suitable for primary and secondary contact use. The size and location of the stream may significantly limit its recreational value, however.

3. Treatment and Discharge

The alternatives for the O'Hare treatment system, as given below, reflect the analyses published in MSDGC planning and design reports. As assumptions of plant loadings and acceptable systems have evolved during the planning process, it is to be noted that the reported loadings and assumptions are not totally consistent with the final design criteria. However, as the relative acceptability of the studied alternative is not influenced by these changes in assumptions, the reported alternatives are germane.

A 1968 Brown and Cladwell preliminary design report as a treatment plant for the O'Hare area used the following effluent standards for preliminary design.

BOD	4 mg/l
SS	5 mg/l
Ammonia	2.5 mg/l
Dissolved Solids	750 mg/l
Fecal Coliform	1000/100 ml

Alternatives for treatment were analyzed by process; preliminary, primary, secondary, and tertiary treatment. The recommended processes were as follows:

a. Preliminary Treatment. Removal of gross floatable mechanically cleaned bar screens with return of ground screenings to sewage flow.

b. Primary Treatment. Removal of grit in aerated grit tanks with grit hauled away for offsite disposal. Removal of floatable material and reduction of suspended solids and BOD in primary sedimentation tanks with skimmings and sludge pumped to offsite areas for treatment and disposal. Design of the primary sedimentation tanks to provide for maximum efficienty in BOD removal.

c. Secondary Treatment. Reduction of substantially all of the suspended solids and BOD by the activated sludge process. Aeration tanks to be designed and operated for maximum oxidation of carbonaceous matter only. Settling of activated sludge in secondary sedimentation tanks with waste activated sludge pumped along with primary sludge to offsite areas for treatment and disposal.

d. Tertiary Treatment. Reduction of suspended solids to a maximum of 5 mg/l and BOD to a maximum of 4 mg/l on rapid sand filters using dual media filter beds. Reduction of ammonia to less than 2.5 mg/l by pH adjustment and stripping. Sludge removed from coagulation and sedimentation tanks to be pumped along with primary and waste activated sludge to offsite areas for treatment and disposal.

The ammonia stripping recommendation, however, was estimated to cost more than an equivalent biological nitrification - denitrification tertiary alternative. The cost for ammonia stripping was estimated at $38 per million gallons, and the cost for a nitrification - denitrification system was estimated at $36 per million gallons. The stripping alternative was recommended by the consultant, Brown and Caldwell because of the following advantages:

1) The process is subject to positive control so that the effluent nitrogen content can be consistently maintained at a given level.

2) Conversion of ammonia nitrogen to nitrate nitrogen is not required. This simplifies operation of the secondary

treatment process and leads to the production of a secondary effluent low in suspended solids and BOD.

3) Ammonia is removed in gaseous form and there are no solid nitrogenous wastes requiring disposal.

4) Treatment with lime not only provides pH adjustment but also reduced the phosphorus and dissolved solids in the effluent at no additional chemical cost.

Two alternate modes of plant operation were given in the report with regard to ammonia reduction, as the choice of the ammonia stripping alternative was not clear cut.

In 1970, the design criteria were revised. This revision reflected the MSDGC's decision to proceed with a biological nitrification tertiary system for ammonia removal.

The following factors indicated the selection of biological nitrification:

1) The Brown and Caldwell ammonia stripping recommendation was estimated by the consultant to cost more than an equivalent biological nitrification alternative, $38 per million gallons versus $36 per million gallons respectively.

2) As denitrification was not required in the immediate future, the cost comparison was $38 per million gallons for stripping against $11 per million gallons for biological nitrification.

3) It was not certain that a stripping system could be operated efficiently in a cold climate.

4.0) Significant chemical additions to the flow stream were required to increase the stream pH and subsequently lower the pH.

The nitrification process selection was based on the above discussion, and the conclusions in the Salt Creek Water Reclamation Plant report. The selected criteria also recognized that while two stage nitrification reflected the most conservative approach to ammonia removal, this technology had not been comprehensively demonstrated on a large scale. As a consequence, MSDGC decided to design the plant so that it could be operated as a conventional one stage plant or as a two stage, nitrification plant.

4. No Action

The no action alternative involves retaining the present wastewater collection system in the service area, with treatment at the MSDGC North Side Plant. This arrangement can continue to accomodate dry weather flows for an undetermined period, but cannot treat the system overload during storm flows. About 80 storm overflows would continue to degrade the area's stream annually.

If no action is taken, the 29 outfalls in the study area will, after December 1977, be in violation of the Water Pollution Regulations adopted by the Illinois Pollution Control Board in July 1973, and approved by USEPA. These regulations require that the effluent from existing combined sewers be given sufficient treatment to prevent pollution or the violation of applicable water quality standards by December 31, 1977.

The amortized costs of treatment processes are determined by the following formula:

Annual Cost = C.R.F. (C + P.W.(R) - P.W.(S))

where C.R.F. = Capital Recovery Factor with interest at 5-7/8% and n = 15

C = Initial Construction Cost

P.W.(R) = Present worth of Replacement Cost at 5-7/8% and varying n.

P.W.(S) = Present worth of Salvage Value at 5-7/8%. Salvage is determined using straight line depreciation.

Wastewater Lift Station and Grit Removal: The wastewater lift stations are designed to pump peak flow of 3180 MGD at 625 ft. of head. The lift station discharges the water to concrete tanks for grit removal prior to biological treatment.

Lift Station Structure & Pumping Facilities @ 44,000 HP and $175/HP	$129 Million
Aerated Grit Tanks & Grit Removal Facilities	43 Million
Total Lift Station & Grit Removal Capital Cost	$172 Million

Aerated Lagoon: The capital costs for the aerated lagoons include earthwork for lagoon cell construction, lagoon slope stabilization, pavement construction, flow structures and mechanical surface aerator-mixers.

Earthwork, Slope Stabilization, etc.	$102.5 Million
Aerator-Mixers	52.5 Million
Total Aerated Lagoon Capital Cost	$155 Million

Storage Facilities: The capital costs for this unit process include site preparation earthwork for lagoon construction, lagoon slope stabilization, pavement construction, flow structures and chlorination facilities.

Earthwork, Slope Stabilization, etc.	$273.6 Million
Chlorination Facilities	29.4 Million
Total Storage Lagoon Capital Cost	$303 Million

Irrigation System: The capital costs for this unit process include irrigation pumping facilities, a flow distribution network and the irrigation machines. The peak capacity of the total system is 4915 MGD.

Pumping Facilities	$ 41 Million
Irrigation Machines	114 Million
Conduits	620 Million
Total Irrigation System Capital Costs	$775 Million

Drainage System: Drain tile, channel construction, sewer pipe, and drainage tunnels are included in capital costs of this unit process. The peak capacity of the drainage system is equal to that of the irrigation system - 4415 MGD.

Total Drainage System Capital Cost	$429 Million

Miscellaneous Land System Components: The land treatment system costs include electrical facility construction in the rural areas together with building structure costs for administration, maintenance and lab buildings and a reclaimed water monitoring system.

Total Miscellaneous System Capital Cost	$130 Million

Land Treatment System - Replacement Costs: The land treatment system replacement costs are programmed capital expenditures for certain treatment components which are to be replaced within the 50 year life of the system. The following replacement costs for the various unit processes of the land treatment system are presented as follows:

Wastewater Lift Station & Grit Removal: For this unit process, 10% of the grit collection and removal facilities are programmed to be replaced every ten years. This is equal to a capital expenditure of $4 Million. Also, 50% of the pumping facilities for the main wastewater lift station are replaced every ten years. This is equivalent to a $65 Million replacement cost.

Aerated Lagoon: The life of the aerator-mixers is ten years. Therefore, 100% of the aerator cost, or $52.5 Million, is programmed to be replaced every ten years.

Storage Facilities: The chlorination facilities are replaced every ten years at a cost equal to 25% of the facilities. For the total land treatment system, this is equal to a $7.35 Million capital expenditure for four times during the life of the system.

Irrigation System: The irrigation pumps are replaced every ten years at a cost equal to 80% of the irrigation pump station. This is equal to $32.6 Million every ten years. Every 15 years, the irrigation machines are to be replaced at a cost equal to 90% of the total capital irrigation machine cost. This is equivalent to capital expenditure of $100 Million every 15 years.

Miscellaneous System Components: Major electrical repairs to the land treatment system are programmed after 25 years of system operation. This replacement cost is equal to 35% of the total electrical facilities cost. This is equal to $45.5 Million for the entire system.

TABLE M-VIII-4 SUMMARY OF CAPITAL, REPLACEMENT AND ANNUAL COSTS:

	Cost ($Million)		
Item	Construction	Present Worth	Annual
Lift Station & Grit Removal	172	164	16.42
Aerated Lagoon	155	143	14.59
Storage Facilities	303	222	22.64
Irrigation System	775	598	61.00
Drainage System	429	416	42.40
Misc. Land System	120	75	7.7
	1,964	1,618	164.75

Capital Present Worth = $1,618 Million

Capital & Replacement - Annual = $164.75 Million

Land Treatment System - Operation and Maintenance Costs: The operation and maintenance costs of the treatment facility components include labor, chemicals and supplies and energy requirements. The main wastewater lift station and aerated treatment lagoons are similar to the treatment plant systems in that they require 24 hours maintenance on a year-round basis. The irrigation and drainage systems require eight hours per day maintenance on a year-round basis. During the winter months, when the irrigation machines are not in operation, labor is still utilized for major overhauls of these machines. The eight hour sick time and weekends are taken into account. The following M & O costs are presented for the major process units.

Labor

Main wastewater lift station & grit removal

1 Supervisor	$ 17,000/year
4 Skilled Labor	61,000/year
1.5 Unskilled Labor	21,500/year
Labor Cost/shift	$ 99,500/year
@ 4.5 Shifts	477,750/year/module
Total Cost	$4.18 Million/year

General plant functions

5 Supervisors	$136,500/year
4 Unskilled Labor	52,000/year
Labor Cost	$188,500/year/module
Total Cost	$188,500/year

Aerated lagoon

1 Supervisor	$ 19,600/year
11 Skilled Labor	157,300/year
Labor Cost/shift	$176,900/year
@ 4.5 Shifts	796,000/year/module
Total Cost	$6.42 Million/year

Storage lagoon facilities

1 Supervisor	$ 15,000/year
14 Unskilled Labor	182,000/year
Labor Cost/shift	$197,000/year
@ 1.5 Shifts	$297,500/year/module
Total Cost	$2.38 Million/year

Chlorination facilities

3 Skilled Labor	$ 58,500/year
@ 4.5 Shifts	263,000/year/module
Total Cost	$2.12 Million/year

Irrigation & drainage system maintenance

1 Supervisor	$ 19,500/year
4 Skilled Labor	70,200/year
4 Unskilled Labor	54,600/year
Labor Cost/shift	$144,300/year
@ 1.5 Shifts	216,000/year
Total Cost	$1.74 Million/year
Total Labor Cost for Entire Treatment System including 15% for fringe benefit costs.	$26.21 Million/year

Chemicals & Supplies for Entire Treatment System

Chlorine @ 4 mg/1 & $0.22/pound	$ 5.94 Million
Main lift station @ 1% Capital Cost/Year (1)	1.29 Million
Aerator-Mixers @ 1% Capital Cost/Yr.	0.53 Million
Chlorination facilities @ 1% Capital Cost/Yr.	0.29 Million
Irrigation pumps @ 1% Capital Cost/Yr.	0.41 Million
Irrigation machines @ 1% Capital Cost/Year	1.14 Million
Transmission facilities @ 0.1% Capital Cost/Year	0.7 Million
Total Chemical & Supply Cost	$10.30 Million/Year

Footnote:

(1) Figure represents capital cost of pump station portion of total Lift Station/Grit Removal Cost = (0.01) (172) (0.76) = $1.29 M

Energy

For the land treatment system, all energy costs reflect electricity requirements for the various components presented herein. These costs are based on an electricity rate of $0.025/KWH.

Main wastewater lift station @ 44,000 HP/Module	$ 67.20 Million/year
Aerated lagoon @ 13,500 HP/Module	17.29 Million/year
Irrigation distribution system @ 38,000 HP/Module & 158 days in operation	21.96 Million/year
Irrigation machines @ 7,100 HP/Module and 158 days in operation	4.05 Million/year
Drainage system @ 14,000 HP/Module and 158 days in operation	7.97 Million/year
Total Energy Cost	$118.47 Million/year

Summary of Labor, Energy, Chemical & Supplies Costs:

Item	Cost ($ Million/year)
Labor	$ 26.62
Chemicals & Supplies	10.30
Energy	118.47
Total M & O	$155.39 Million/year
Present worth - M & O =	1,525 Million

Land Treatment System - Land Costs: Associated with the land treatment system are a number of land costs and annual land payments. For the land treatment system, the only land that is purchased is for the lagoon facilities. The cost of land, together with relocation costs for families or buildings on this land, are developed on a per acre basis as discussed in detail in the land displacement subsection of Section VII A of Appendix B C-SELM Report. For the modular land treatment system, some 5,600 acres of lagoon land are required to accomodate the 265-MGD average daily flow. The unit land and relocation cost for this module is $1,265/acre. Including a 20% contingency cost factor and a 15% engineering, design, legal and administration fee, the total land cost for the land treatment system is some $79.0 Million.

Also associated with the land treatment system are initial and inconvenience payments to the participating landowners in the amount of 10% of the present land value within the irrigation system. This payment is used to help the participating farmer defray the cost of new agricultural equipment and also to pay for any loss in crop revenue due to construction of the land treatment system. Based on a gross irrigation land requirement of $532,620 acres, an average land value of $745/acre and a contingency cost factor of 20%, the initial and inconvenience land payments equal $47.6 Million.

Finally, an initial land cost is paid to people residing within the site boundary who presently utilize shallow wells as a water supply source. The cost includes provisions for constructing deeper wells (200 feet) to replace existing shallow ones so that the rural communities' water supply is isolated from the potable, reclaimed land treatment effluent which interfaces with the groundwater supply. The well cost, including contingencies, equals $2,000 per unit. Therefore, total cost equals $12.7 Million.

Annual Payments: Included in the land cost analysis for the land treatment system is a recognition of the fact that purchased lagoon facilities remove lands from the tax base and hence create an annual tax loss. Based on the modular design requirement of 5,600 acres of lagoon land, an average land value of $745/acre, an average rural tax multiplier of $2/$100 of assessed valuation and a contingency factor of 20%, some $1.9 Million per year of tax revenue will be lost through construction of the Land Treatment Facility. In order to make up for this annual tax loss, a unit tax revenue treatment cost of $1/MG of treated influent is assessed. The revenue from this tax will be $0.772 Million/year.

Also an annual land cost payment is paid to the participating landowner since his land will be unavailable for other uses during the 50-year life of the treatment system. This annual cost, which is also based on the gross irrigation area utilized by the system, is equal to 4% of the present land value. Based on the total land system requirement of $532,620 acres, an average land value of $745/acre and a contingency cost factor of 20%, the annual land payment is equal to $19.04 Million/year.

Summary of Land Costs:

Initial Construction Costs:

Land reqd. for Lagoons	$ 79.0 Million
Initial and Inconvenience Payment	47.6 Million
Water Supply Costs	12.7 Million
Total	$139.3 Million

Annual Costs:

Loss of Tax Base	$ 1.90 Million/year
Tax Revenue	0.77 Million/year
Payment to Participating Farmers	19.04 Million/year
Total	$ 21.71 Million/year
Total Present Worth	$382
Total Annual Cost	$ 39 Million/year

Stormwater Management Systems

In contrast to the C-SELM Wastewater Management System, the MSDGC's Land Treatment Alternative includes only those costs associated with the management of Urban Stormwater.

The costs connected with the management of urban stormwater are taken from the Summary of Technical Reports by the Flood Control Coordinating Committee dated August, 1972, for the Chicago Underflow Plan. These costs include surface collection and drop shafts, conveyance tunnels, storage reservoir facilities, pumping stations and discharge conduits.

The estimate costs for the Chicago Underflow Plan are summarized below: (Cost reflects 1972 prices.)

Surface Collection and Drop Shafts	$ 93,000,000
Conveyance Tunnels	567,200,000
Storage Reservoir Facilities	350,000,000

Pumping Stations and Discharge Conduits	
McCook-Summit	$ 30,000,000
Calumet (Temporary)	6,000,000
O'Hare Northwest	2,000,000
Subtotal	$1,048,200,000
Undefined Work & Contingencies	100,000,000
Total Construction Cost	$1,148,200,000
Engineering, Legal & Administrative	75,000,000
Total Project Cost	$1,223,200,000

The revised estimated equivalent annual costs for operation, maintenance, equipment replacement and water for aquifer protection for the recommended plan are as follows:

Maintenance and Operation	$ 8,700,000
Equipment Replacement	1,000,000
Aquifer Protection	3,900,000
Total	$ 13,600,000

Conveyance System: For estimating the cost of the conveyance system, the following assumptions were used:

1. Minimum velocity in the Tunnel = 2.0 fps and Manning coefficient = 0.017.
2. Functional headloss in the Tunnel could not exceed 150 ft. over the entire length.
3. Total distance from the main access point (WSW-STW) to the Land Treatment Site is approximately 70 miles.
4. Tunnels are assumed to be unlined, mole-excavated structures and their costs are based on experience gained by the City of

Chicago over the past few years. Three such tunnels have recently been constructed: These are:

a. Lawrence Avenue Tunnel, 5.5 miles long, upper diameter 12 feet, lower diameter 17 feet, cost about $10 million, including allowance for concrete lining.

b. Crawford Avenue Tunnel, 3.5 miles long, diameter about 16 feet, cost about $7.5 million, including concrete lining.

c. Forty-Seventh Street Tunnel, 3.5 miles long, diameter about 16 feet, cost about $7.5 million, including concrete lining.

All three of these tunnels were let by competitive bidding with construction to include concrete lining. After experience with the "mole" construction, it was decided to eliminate the concrete lining as the bored hole proved to be smooth and strong. Both hydraulic capacity and storage capacity would have been reduced by the concrete lining. Infiltration into the tunnel was found to be controllable through grouting at selected locations, and roof spalling was found to be almost nonexistent.

Present costs for unlined mole-tunnels range from $200 per foot for a 10-foot diameter, and $300 per foot for a 16-foot diameter up to $1,000 per foot for a 35-foot diameter. These figures correspond to $1.50/cu.ft. for a 16-foot diameter and $1.00/cu.ft. for a 35-foot diameter. The cost curve for an unlined mole tunnel is enclosed as Figure B-VI-E-1 of the C-SELM Report.

Tunnel drop shaft costs are estimated from the cost curve presented in Appendix B, Section VI-D, Figure B-VI-D-2, C-SELM Report.

Capital Cost: 36 ft. diameter, unlined Tunnel. 70 miles...Cost = $505 Million.

Operation and Maintenance Costs: Operation and maintenance costs include labor and material required for regular operation and maintenance of pressure conveyance lines, tunnels, and pumping stations. Cost of power required to run the pumping station is also included. Labor costs include salaries for superintendents, operators, clerks, laborers, electricians and other tradesmen. Materials include all the necessary implements for normal operation of the system. Energy costs are estimated at $0.025 per KWH. Labor and material costs are estimated at 0.5% of capital costs plus contingencies (at 20% of capital cost).

Replacement Costs: Replacement costs are only applicable to pumping stations. Tunnels and pressure lines are estimated to last the life of the project and have no replacement factors. The following replacement schedule is pertinent:

Component	% of Total Cost	Replacement Required in Years
Land and Structure	60	None in 50 years
	20	Every 25 years
Mechanical	10	Every 10 years
Other	5	Every 10 years
	5	None in 50 years
Total	100	

The schedule indicates that 20% of capital cost, plus contingencies at 20%, of capital cost of the pumping station will need replacement at the end of the 25th year of operation. Mechanical components such as pumps, valves, etc., plus other parts, will be replaced at scheduled ten-year intervals or four times in the life of the project.

Summary of Conveyance Cost

Present Worth

Capital	$355 Million
M & O	30 Million
Total	$385 Million

Annual Cost

Capital	$ 36 Million/Yr.
M & O	3
Total	$ 39 Million/Yr.

Sludge Management System: The sludge disposal option selected for the MSDGC's Land Treatment Alternative is Land Reclamation. Of the three possible Land Reclamation sites mentioned in the C-SELM Report, the Fulton County site is assumed to be the selected site. This appeared to be a logical choice because the MSDGC is presently operating a land reclamation project of its own in Fulton County.

The sludge management cost for the Land Treatment Alternative consists of three major components: 1. dredging costs for removing sludge from the storage lagoons; 2. transportation costs for pumping the sludge to the Land Reclamation site; and 3. application costs for distributing and applying the sludge onto the land.

Costs associated with dredging sludge from the storage lagoons, however, are developed using a scheme conceptualized by MSDGC. This was necessary because of the rather sketchy treatment of the subject in the C-SELM Report.

Both transportation and application cost are developed using the basic assumptions delineated in the C-SELM Report. These assumptions, with slight modifications, are:

Dredging: MSDGC has had experience in sludge removal from lagoons utilizing two methods: mobile and stationary. In the mobile method, dredging machines scrape the bottom of the lagoons and pump the sludge to a collection point. In the stationary method, sludge is brought by a dragline system from where it is pumped out of the lagoon.

Considering the area of the storage facilities (ca. 5000 acres per module) involved, neither of the above methods appear to be feasible. Therefore, the conceptualized sludge dredging operation for the Land Treatment Alternative includes such items as permanent sludge drawpoints which are thought to be required to make the method workable.

Capital Costs

Collection Conduits and Drawoff Structures	$52 Million
Dredging Machines	$ 1 Million
Total Construction Cost	$53 Million

Replacement Cost $1.0 Million

Amortized Capital & Replacement Cost = $4.0 Million/yr.

Labor Costs

3 Supervisors	$ 80,000/yr.
24 Operating Engineers	500,000/yr.
36 Laborers	590,000/yr.
12 Skilled Tradesmen	251,000/yr.
Total	$1,421,000/yr.

Energy Costs

24 Dredging machines operating
8 hrs. day 182 days per year
200 H.P. per machine - Diesel
Fuel @ $0.45/gal.

Summary of Dredging Operation·

Capital - Present Worth	$ 39.76 Million
Capital & Replacement - Annual	$ 3.99 Million/year
M & O - Present Worth	$ 18.12 Million
M & O - Annual	$ 1.25 Million/year

Sludge Transportation: Analyses of costs associated with sludge transportation systems indicate that transportation cost varies with the solids content of the sludge. A preliminary cost analysis, comparing each mode of sludge transportation including pipeline, truck, barge, and railroad, indicates that a pipeline system is the most economical means of transportation when the solids content of the sludge transported is maintained at the 6% level for biological sludges and 10% for physical-chemical sludges. This analysis is based on the assumption that a railroad or waterway exists between the transfer station and the land application site.

In the final determination of the biological sludge transportation costs for this study it is assumed that sludge thickening, combined with barge or railroad systems of transportation, could produce unit costs comparable to those for the pipeline system. While the costs for a pipeline transportation system are used as the sludge transportation costs for this study, they are not necessarily any less than the costs for the most economic version of either of the alternative rail or barge transportation systems.

The cost for a pipeline transportation system is developed using the following basic assumptions:

1. Pipe size and the horsepower required at the pumping station are determined using a design flow of 13 MGD and pumping sludge to the Fulton County Land Reclamation Site.

2. The average cost of installed pipeline equals $2 per inch of diameter/linear foot of pipe.

3. The cost of the pumping stations is taken from the unit costs of pumping stations developed for wastewater conveyance.

Figure B-VI-C-1 of C-SELM Report and corrected using a factor of 1.32 to compensate for the increase in power and in physical size of the pumps and motors.

4. Labor costs equal 1.8% of the construction cost per year.

5. Energy costs are based on a unit cost of $0.01/KWH and 24 hours per day operation.

6. Maintenance and supplies equal 0.6% of the construction costs.

7. Replacement costs for a pumping station and associated pipeline are computed using the following schedule.

REPLACEMENT SCHEDULE

Components	% of Total Cost	Replacement Required in Years
Land & Structures	20%	No Replacement in 50 Yrs.
Structures & Pipeline	60%	Every 25 Yrs.
Mechanical	10%	Every 10 Yrs.
Other	5%	Every 10 Yrs.
Other	5%	No Replacement

1. Capital Costs

Sludge Pipeline	$50.68 Million
Pump Stations	0.73 Million
Total	$51.41 Million

Replacement Cost = $545,000

Amortized Capital and Replacement Cost = $4.39 Million/year

2. Labor Costs

1.8% (Construction Cost = $51.41 Million) = $930,000/year

3. Energy Cost

Sludge pumping $100,000/yr.

4. Maintenance & Supplies

0.6% (Construction Cost = \$51.4 Million) = \$310,000/yr.

5. Summary of Transportation Costs

Capital - Present Worth	\$43.03 Million
Capital & Replacement - Annual	\$ 4.39 Million/year
M & O - Present Worth	\$13.12 Million
M & O - Annual	\$ 1.34 Million/year

Land Application Systems: The costs for the sludge distribution system, land clearing, and construction of sludge storage lagoons are included in the following land application cost estimate. The costs for land application systems are developed using the following basic assumptions:

1. The system designs are based on the design criteria described in Appendix B, Section IV-C of the C-SELM Report.
2. The same methodology for the pipeline transportation system is used here for the computation of pumping station and pipeline costs.
3. The costs of fittings are based on responses from manufacturers and contractors for each particular type and size required. No general rule is used.
4. The cost of a tractor plus plow is assumed to be \$32,000.
5. Land clearing costs for land reclamation is \$500/ac.
6. The land reclamation application system is designed so that once the desired quantity of sludge is applied to a 1400 acre unit, the system is abandoned and a new one is utilized on adjacent lands. Thus in a strict sense, there is no replacement schedule for this sludge application system. However, the construction of all the sludge application units during a five or ten year period is not feasible since certain units would not be utilized for 20 to 40 years after their construction. Thus a construction schedule is substituted for the replacement schedule. The initial construction is designed to accommodate one-fourth of the total sludge application requirements. At 10 year intervals, three more application system construction projects are programmed with each providing one-fourth of the total system requirements.

Typical cost analyses for the land application of sludge are given in Table B-VI-C-2 C-SELM for land reclamation. These costs are based upon the layouts of Figures B-IV-C-3 and B-IV-C-6 of the C-SELM Report including an allowance of $1,000,000 per unit for distribution costs from the end of the main sludge transportation system to each unit. This allowance is required because of the commonly scattered locations of application areas within a general region, requiring additional pumping stations and pipelines to convey the sludge from the main supply point in that region to each new distribution unit being developed.

Capital Costs

Sludge Storage Lagoon	$1.27 Million
Distribution System	3.38 Million
Pump Station	0.50 Million
Tractor/Sprinklers	1.82 Million
Land Clearing	2.98 Million
Total	$9.95 Million

Labor:

Pump Station

1 Supervisor	$ 18,000/yr.
2 Skilled Labor	42,000/yr.
2 Unskilled Labor	33,000/yr.
	$ 93,000/yr.
Total @ 4.5 Shift	$418,000/yr.

Sludge Distribution

2 Supervisors	$ 42,000/yr.
56 Heavy Machine Operators	1,172,000/yr.
Total (Only 1 Shift)	$1,214,000/yr.

Pipe Disassembling & Installation

2 Supervisors	$ 42,000/yr.
5 Operating Engineers	105,000/yr.
10 Unskilled Labor	165,000/yr.
Total (Only 1 Shift)	$312,000/yr.

Equipment Maintenance

1 Supervisor	$ 21,000/yr.
5 Skilled Tradesmen	105,000/yr.
5 Unskilled Labor	82,000/yr.
	$208,000/yr.
Total @ 1.5 Shift	$162,000/yr.

Total Labor Cost = $2.54 Million/Year

Energy

Pump Station	$ 40,800/yr.
Sprinkler/Tractors	1,060,000/yr.
Total	$1,100,800/yr.

Supplies

10% (Construction Cost) =	$1.42 Million/yr.

Land Clearing

Clearing 5950 ac/year =	$2.98 Million/yr.

Summary of Land Application:

Capital - Present Worth	$18.05 Million
Capital & Replacement - Annual	1.82 Million/Year
M & O - Present Worth	41.02 Million
M & O - Annual	4.19 Million/Year

Summary of Sludge Management Costs

Capital - Present Worth	$100.84 Million
Capital & Replacement - Annual	10.20 Million/Year
M & O - Present Worth	72.26 Million
M & O - Annual	7.28 Million/Year

Reuse Conveyance System

The only reuse system contemplated for MSDGC's Land Treatment Alternative is that for navigational purposes. The capital cost of water reuse system therefore includes pumping station at various injection points and return flow tunnels only.

Capital:

Tunnels

Main Tunnel	$350 Million
Calumet to WSW	72 Million
WSW to N.S.	28 Million
WSW to O'hare	11 Million
Other Points	13 Million
Total	$474 Million

Pump Stations

WSW	$ 63 Million
Northside	18 Million
Calumet	18 Million
Others	8 Million
Total	$107 Million

M & O:

Labor for Pump Stations

WSW P.S.	$396,000/yr.
Northside P.S.	242,000/yr.
Calumet P.S.	242,000/yr.
All Other P.S.	400,000/yr.

Labor for Tunnels (0.005) (474) =	$2.37 Million/yr.

Energy

All Pump Stations	$55.7 Million/yr.

Supplies - 1.0% of Capital Cost

(0.01) (107) =	$1.07 Million/yr.

Summary of Reuse Conveyance Costs:

Present Worth

Capital	$ 410 Million
M & O	591 Million
Total	$1001 Million

Annual Cost

Capital	$ 42 Million
M & O	60 Million
Total	$ 102 Million

Rock and Residual Soil Management Systems: The costs associated with the selected management and transportation methods are estimated from available sources, including reports containing applicable information and interviews with people in the materials and transportation fields. The resulting basis of cost information presented here is not detailed but constitutes a best attempt to assign reasonable costs to an enormous materials-management program.

Moled Rock from the Urban Areas: It is assumed that one-third of this rock is to be used in the vicinity of its origin. The cost for loading (crushing is not required for moled rock), transport and placement is estimated to be $0.50/ton by using truck transport of less than 5 miles in city driving. For the remaining two-thirds of the rock, the same $0.50/ton is assumed to transport the rock to a rail loading station. The rail loading, transport, unloading, and placement is then estimated to be the same $1.13/ton as is estimated for rock from the McCook-Summit site. It is assumed that the savings from elimination of rock crushing will be offset by smaller volumes and longer hauls. Thus, for each ton of moled rock produced in the urban area, an average cost is:

$$1/3\ (0.50) + 2/3\ (0.50 + 1.13) \quad = \quad \$1.26/\text{ton}$$

An average cost of $1.26/ton is used to obtain the total cost of managing all of the moled rock from the urban area.

Total Cost	$6.86 Million

Overburden, Mined Rock and Moled Rock in the Rural and Suburban Areas: All of this material is assumed to be used in landscaping open space. Transport is by truck and the distance varies for different locations. A unit of $0.75/ton is assumed to apply to all of the materials.

This assumes a haul distance of 10-15 miles for overburden and moled rock and somewhat less for mined rock, where crushing is required.

Total Cost	$285 Million

It is assumed that much of the residual rock can be sold. Therefore, actual cost is reduced by 75%.

Present Worth	$ 48 Million
Annual Cost	$ 5 Million/Yr.

TABLE M-VIII-5 Summary of Land Treatment System Cost Estimate ($Millions)

	Present Worth			Annual		
	CAP.	M & O	Total	CAP.	M&O	Total
Treatment	$1618	$1525	$3143	$165	$156	$321
Land	382	--	382	39	--	39
Sludge Mngmt.	101	72	173	10	7	17
Conveyance	355	30	385	36	3	39
Reuse Convey.	410	591	1001	42	60	102
Res. Soil & Rck. Mangmt.	--	48	48	--	5	5
Total	$2866	$2266	$5132	$292	$231	$523

APPENDIX M

Solids Handling Alternatives

1. Solids Stabilization Processes

The principal purposes for solids stabilization are to render the material less odorous and putrescible and to reduce the pathogenic organism content. The processes which were examined included anaerobic and aerobic digestion, composting, lime treatment and thermal methods.

a) Anaerobic Digestion

There are two general types of anaerobic digestion processes. They are the widely used heated anaerobic digestion process and the unheated anaerobic digestion process. They are well established means of biological sludge stabilization.

Anaerobic digestion has a low energy requirement. Power consumption is much less than that required for other stabilization methods considered. The digester gas produced during anaerobic digestion has a heating value of approximately 700 BTU/cubic foot and is used as source of fuel for the digester processing heating requirements and/or other plant energy requirements.

Following the anaerobic digestion process, a stabilized sludge of 4.0% solids is produced containing nutrients of 6% nitrogen (as N), 2.4% phosphorus (as P) and 0.4% potassium (as K) on a dry basis. Thus, the sludge is suitable as an agricultural fertilizer. At present market costs, the MSDGC's stabilized sludge has a commercial value, based on nutrients, of $17.28/dry ton. This does not include the humic content and its economic worth.

b) Aerobic Digestion

The process of aerobically digesting sludge is a modification of the activated sludge process. It is based on the principle that biological cells will use their own cell material and dead cells present as food in the absence of an external source of nutrients in the environment. The process is made viable by the continuous aeration of the waste sludge so that the sludge is always in the auto-oxidation phase.

Tests conducted in aerobically digested sludge showed: (1) a fairly high degree of digestion, (2) no disagreeable odor, (3) nitrification and (4) improved drainability of the digested sludge. Also, the supernatant contained a low biochemical oxygen demand (BOD) and therefore would not create as great a BOD load increase as an anaerobic digester supernatant when recycled to the plant for treatment.

Aerobic digestion has the advantage over anaerobic digestion, in that there is considerable reductions in supernatant BOD. Significant reduction in ammonia-nitrogen has been observed in aerobic digestion.

c) Composting

Composting is a method which converts sludge into a relatively safe humus-like material suitable for both land application and landfilling.

Wastewater sludges that do not contain chemicals toxic to microbial decomposition can be thickened and composted in combination with relatively dry wastes. Raw sludge alone may also be amenable to aerobic decomposition in a mechanical composting unit with forced aeration, but such sludge is generally gelatinous and has particles too fine for proper aeration.

Composting may be defined as the aerobic thermophilic decomposition of organic solid wastes to a relatively stable fibrous humus-like material called the compost. Decomposition is accomplished by various microorganisms including bacteria and fungi.

Composting has been used in Europe and Asia for many centuries. It is an outgrowth of age-old agricultural process in which various types of organic matter are used to increase crop yields and continues to be used in Europe and Asia.

Depending upon the system used, the composting mixture can develop temperatures of 120°F or higher within a few hours to a few days and can be free from pathogens within a period of one day to several weeks. Successful killing of pathogens depends upon good turning, mixing and aeration. As composting progresses, the material appears to be increasingly less capable of supporting pathogenic organisms. In open air windrowing, curing follows the active digestion period. For curing, the mass is stored as a large pile herein heating continues for about a month and the number of pathogens is reduced to a very low level.

Composting can be done to both digested and undigested sludges using suitable bulking agents.

Wilson and Walker reported no problems with open air windrowing of digested sludge with wood chips during mild weather, but severe rain or below freezing temperatures hampered their operation. Processed compost was successfully used for bulking and seeding the compost feed in Los Angeles County.

Compost in this country has had a history of failure as a commercial venture. Isolated cases of marketing the compost are reported but this does not necessarily mean that compost can be sold to support the operation.

d) Lime Stabilization

Raw primary and secondary sludges can be stabilized by adding lime in a 25% slurry form. The process of lime addition can either be a continuous or a batch one. The addition of lime to the raw sludge increases its pH. Satisfactory stabilization can be achieved by lime treatment at such a dosing (approximately 200-300 lbs/dry ton for primary and 600-1000 lbs/dry ton for secondary sludge) that the treated sludge reached a pH value in the range of 12.2 to 12.4. The pH of the treated sludge must be maintained above 11 for 14 days or more in order to make it acceptable as a fertilizer.

Experience with lime stabilized sludge indicated that it can be ultimately disposed of on land. However, caution must be exercised to ensure that no deleterious effects such as odor generation or pest breeding occurs during or after application.

e) Thermal Processes

Thermal processes for solids stabilization and solids reduction are widely used. Included in this category of thermal processes are heat drying and incineration.

The disadvantages of heat drying are as follows:

1) High energy consumption because 1000 BTU/lb of water is required for drying the sludge. An additional energy demand is required to oxidize odorous organic compounds volatilized in the drying process.

2) High efficiency scrubbers are required to conform to the IEPA particulate emission code.

Incineration and ash disposal are used by many municipalities for solids reduction and disposal. Incineration oxidizes the volatiles in the sludge solids and the resultant ash and operated incinerator can meet the stringent emission standards.

Of the many types of incinerators, only the multiple hearth and the fluidized bed incinerators have found wide acceptance for sludge incineration. Other types of incinerators such as rotary kilns, atomized suspension, cyclone reactors, flash dryers, and chain and grate, have operating difficulties because of poor mixing of the combustibles and air. Also these units have relatively small heat sinks making the operation too dependent on sludge characteristics, thus making continuous operation difficult. Therefore, these units are not efficient for sludge incineration.

One of the major drawbacks of incineration as a means of solids reduction is the great demand it puts on energy resources. This is mainly due to the fact that normal dewatering methods produce a sludge cake with relatively low solids content, often containing a high portion of chemicals to aid dewatering. Therefore, incineration consumes fuel to drive off large quantities of water before the moisture content of the cake is reduced to the point where combustion becomes self sustaining.

The present energy shortage makes the energy intensive incineration system economically unattractive. Coal can be considered an alernative fuel for incineration, but present air quality standard for SO_2 emissions would necessitate scrubbing equipment, more relaxed ordinances, or the use of low sulphur coal. Therefore, the uncertainty over the future availability of natural gas, oil, or low sulphur coal would place the incineration process low on a list of possible solids reduction process alternatives that the MSDGC might consider at this time.

2. Solids Dewatering

In order to obtain maximum operational flexibility with respect to the existing solids processing methods and the proposed alternate methods for final solids disposal, mechanical solids dewatering processes were investigated by the MSDGC. The primary objective of any solids dewatering operation is to prepare the material for the next step of the process, whether it be incineration, landfilling, heat drying, or land application. Solids dewatering has been achieved, using various mechanical methods, namely, but not limited to, vacuum filtration, centrifugation, plate and frame filters, and the belt filter press.

a) Vacuum Filtration

Vacuum filtration is probably the most widely used mechanical method of dewatering sludge. Its popularity accounts for the following advantages: (1) a wide variety of sludges can be dewatered; (2) filters occupy a smaller space than sand beds or lagoons and are unaffected by climate; (3) a relatively dry filter cake that can be incinerated is produced, which eliminates the need for digesters; (4) the solids capture can be good, and (5) plant operations are improved because filters offer some flexibility in scheduling so dewatering can be coordinated with other treatment processes.

From a negative point of view, important disadvantages of the vacuum filtration are: (1) high operating cost due mainly to excessive chemical requirements; (2) frequent media binding required shutdowns, washing and a resultant high labor cost; (3) odors from filtering raw sludge; (4) the need for more highly trained filter operators than are required by other dewatering techniques; (5) lack of scientific control to accommodate fluctuation in sludge quantity and quality; and (6) the necessity for additional handling steps because filtration does not represent ultimate sludge disposal.

b) Centrifugation

The increasing use of centrifuges in the wastewater treatment field is a result of recent improvements in centrifuge design and the availability of reliable performance data. Its growing popularity counts on the following advantages:

1) The capital cost is low in comparison with other mechanical equipments.
2) The operating and maintenance costs are moderate.
3) The unit is totally enclosed so odors are minimized.
4) The unit is simple and will fit in a small space.
5) Chemical conditioning of the sludge is often not required.
6) The unit is flexible in that it can handle a wide variety of solids and function as a thickening as well as dewatering device, and
7) Little supervision is required.

Overall, the operating characteristics of the centrifuge was superior to that of the belt filter press and vacuum filter when analyzed on digested waste activated sludge.

With respect to chemical costs, an effective dosage rate of 9 lbs. polyelectrolyte per ton solids, achieving solids recovery values of 97.6%, reflects chemical costs of $12.63/dry ton solids for chemical addition to the belt filter press.

The adaptability of centrifugal dewatering of digested sludge is a suitable compliment to anaerobic digestion in the application of a dry solids on land ultimate disposal mode of operation.

c) Belt Filter Press

The unit consists of two endless belts, similar to conveyor belts, which run between pairs of rollers and a rotating cylindrical mixing drum in which the sludge and polymer are mixed prior to deposition on the moving belts. The rollers are adjusted in a manner which gradually brings the belts closer and closer together, thus applying increasing pressure to the sludge that is carried between them. It is in this pressure zone that the filter cake is formed. Scraper blades at the discharge end of the press then remove the cake from the belts. After passing the blades, spray jets back-wash both belts to remove any solids trapped in the fabric.

d) Plate and Frame Filter

This technique uses a porous media to separate the solids from the liquid. The filter consists of alternating a series of plates and frames with porous media placed between each plate and frame. After precoating the filter media, the sludge is pumped into the press. The cake which is formed also acts as a filter medium. The plate and frame filter produces the dryest cake and has the highest solids recovery of any mechanical dewatering device. The major drawbacks are high capital and operating costs.

3. Final Solids Disposal

The final solids disposal options available to the MSDGC are landfill and land application. At the present time, the MSDGC uses land application as a method of final disposal. However, for planning purposes, both methods are considered viable techniques. Therefore, various combinations of solids stabilization processes together with the two final disposal techniques, taken singularly or together, were evaluated.

a) Land Application

Land application of stabilized sewage solids recycles the wastes and enhances agricultural production. The method of sludge disposal utilizes the fertilizer value for the positive benefit to the environment. Recycling solids to land for crop production has been practiced as early as 1895 and is presently utilized in many municipalities in this country and extensively in Europe.

The major steps in utilization of wastewater solids in a land application program are as follows:

1) Stabilization of the solids.
2) Transportation of the solids to the application site.
3) Distribution on the application site.
4) Planting and harvesting crops which remove the nutrients.
5) Continuous monitoring of environmental and ecological factors.

Studies on application of digested sludge indicate that nitrogen loading is the controlling factor. Studies indicate that 2" of liquid fertilizer per acre per year supplies the necessary nitrogen consumed by non-leguminous crops. Removal of nitrogen in the fertilizer increases loading rates. Removal can be accomplished by lagooning prior to application is the optimum method of stabilizing the sludge solids.

The practice of land application of stabilized sewage solids to enhance agricultural production has advantages as follows:

1) It does not contribute to any environmental pollution (air or water).
2) It conserves the organic matter for beneficial use.
3) It is economical.

4) It is permanent, i.e., it completed the natural cycle.

b. Sanitary Landfill

Sanitary landfilling is a method of disposal that involves spreading and compacting the solid wastes into cells and covering them each day with earth in a manner that poses no threat to the public health of environment.

The major problems associated with landfills are the production of leachate which may contaminate the groundwater and the accumulation of gas which may catch fire or explode. The disadvantages of the sanitary landfills for sewage sludge include determination of a location which is economically accessible to the plant, the dewatering of digested sludge to 30% cake dryness to reduce leachate problems, the collection and treatment of leachate before discharge to surface waters and the monitoring of local groundwater conditions to maintain water quality.

4. Environmental Considerations of Solids Stabilization Processes

a) Anaerobic Digestion

Anaerobic digestion converts raw materials, such as fats, proteins, and pathogenic organisms to more acceptable or more easily disposable products. Such stabilization is required when it is to be followed by final disposal by landfilling or land application. Gas produced in the process is captured and, being principally methane, can be utilized as a fuel supplement for total energy requirements of the plant. Occasional wasting of excess gas by flaring will cause a discharge of non-combustible gases, such as carbon dioxide and water vapor, posing no air pollution problem. Energy is consumed by heating the digester contents and mixing with recirculation pumps. The consumption is minimized by using external heat exchangers with high transfer coefficient, and non-clog centrifugal recirculating pumps, with supplemental gas compressors for mixing.

Energy consumption is reduced further by the use of fill material around the digester structure to reduce process heat losses. The anaerobic digestion system is self-contained in that it places no environmental demand or ground and surface waters, or any ecosystems.

b) Aerobic Digestion

Aerobic digestion produces a biologically stable end product suitable for subsequent treatment. Unless denitrification is utilized, the nitrates will remain in the sludge supernatant eventually being transported to the final effluent.

The inability to utilize any methane gas from the stabilization process may result in high operating costs. The sensitivity of the biological reaction rates at temperatures below 15 C (59°F), adequate mixing and dissolved oxygen levels and general unclear design parameters at present stages of technological development create environmental risks which would make this system unsuitable for a favorable environmental evaluation.

c) Composting

Composting of wastewater solids converts the organic wastes to a humus valuable as a soil conditioner, and nutrient source. Nutrients are then returned to the soil. A good compost could contain as much as two percent nitrogen, one percent phosphoric acid and many trace elements.

The use of raw sludge is preferable because of its higher nitrogen content. It is environmentally advantageous to be able to use solid wastes along with sludge solids. The final produce is non-odorous and easily handled.

Environmental disadvantages of the process are mainly the energy requirements for the numerous steps: transportation of raw materials to the compost site, dewatering of sludge, trash separation, grinding and blending of solids, turning of compost, regrinding and further processing for commercial sale.

Aerobic decomposition proceeds generally at a temperature in excess of 140°F, sufficient to kill many pathogens, but many strains of Shigella and Salmonella have been isolated from compost made with air dried sewage sludge. There is a potential for public nuisance problems involving odors, insects and rodents.

d) Lime Stabilization

Lime, in sufficient quantities to maintain highly alkaline condition, stabilizes sludge and destroys pathogenic microorganisms.

Lime treated sludge would be disposed of by land application or sanitary landfill. Essentially no organic matter is destroyed with lime treatment and a drop in the pH to near neutrality would cause a regrowth of microorganisms and resulting noxious conditions.

Although lime has been demonstrated to be an effective preconditioner for mechanical dewatering, its use as an individual process for stabilization of biological sludges does not appear to have the environmental reliability of other processes.

e) Thermal Processes

The heat drying process has a net positive environmental effect. The dried solids derived from a waste material is returned to productive use as a soil conditioner and fertilizer. An adverse aspect of the heat drying process is its high energy requirements.

Air pollution is minimized by providing effective scrubbers and by use of afterburners or integral high-temperature processing of the gaseous combustion products. Scrubber water may be plant effluent to preserve water; it should be returned to the plant for treatment to remove suspended solids. The sterile ash may be flushed out of the incinerator outlet to a settling lagoon or removed for landfill. Sometimes ash is recycled as a conditioning agent or filter aid. Ash containing lime may be returned to the conditioning step to conserve chemicals.

5. Selection of Solids Stabilization Processes

Based on the survey presented in MSDGC's facilities planning overview report, the following conclusions were reached.

a) Heat anaerobic digestion will be utilized because:

1) Costs are well defined and the method is cost-effective.

2) MSDGC has design and operating experience.

3) No adverse environmental effects are known to exist.

b) Aerobic digestion will not be utilized because:

1) Preliminary estimate indicates that this process is not as cost-effective as the heated anaerobic process.

2) Technology is not well developed.

c) Composting will not be considered because:

1) Unreliability of cost data.

2) Possible adverse environmental effect.

3) Pilot plant program is required.

d) Lime treatment will not be considered because:

1) Technology is not well defined.

2) Uncertainty exists in regard to environmental effect.

3) Overall evaluation is that the process merits pilot study investigation.

e) Incineration for solids reduction will not be considered because:

1) The high energy requirements of the process.

2) At present, questionable guarantee of producing an environmentally acceptable air product.

6. Environmental Considerations of Solids Dewatering

Dewatering is a necessary part of the stabilization process preparatory to final disposal of sludge by landfilling or incineration, and may also be used to provide a product suitable for land application.

Environmental effects are dependent both on the type of equipment and the feed material. Undigested sludge may cause local odor problems, primarily within the building housing the equipment. Centrifuges are totally enclosed and thus cause no odor problems. When dewatering digested sludge, the filtrate or centrate, in addition to carrying suspended solids back to the treatment plant, will return dissolved BOD, nitrogen compounds and phosphorus compounds. The latter, nitrogen and phosphorus, will remain in the plant flow.

If the dewatered sludge cake is to be incinerated, the solids content of the cake will be a factor in determining the need for fuel energy in the process, as will the chemicals retained in the cake when it is necessary to use chemical conditioning, and as will the proportion of volatile solids. Since digestion converts volatile solids to gases or to liquids, it is environmentally more effective to incinerate undigested sludge, requiring less fuel energy.

7. Environmental Considerations of Final Solids Disposal

a) Land Application

Application of sludge to the land for conditioning of soil and fertilization of plans has the environmental advantage of recycling nutrients to their origin, so that they may be reused. The purpose is to accomplish economical waste disposal in a beneficial manner. Sludge may be applied to land in three forms, liquid, dewatered or dried.

Application of sludge in the liquid form is advantageous because of the difficulty in dewatering most waste sludge, the improvement in nutrient removal in the treatment plant because liquid removed from the sludge is not recycled, the liquid serving as a source of irrigation water, and the convenience in transporting and distributing to the land. Disadvantages include the necessity to handle large volumes of liquid, the energy requirements for moving such large volumes over great distances, the difficulty in controlling distribution so as to minimize aerosol formation and the dissemination of odors, and the high ammonia nitrogen content of the liquid. A report, "Environmental Assessments of the Prairie Plan - Fulton County, Illinois", contains an extensive discussion of the environmental factors associated with the application of digested sludge in the liquid form.

b) Sanitary Landfill

Sanitary landfills are used as final disposal sites for dewatered stabilized sludges or incinerator ash. A sanitary landfill differs from uncontrolled dumping in that the form requires a systematically depositing and covering with earth to control the environmental impact.

The land costs and dewatering requirements can be major cost factors in the design of a system. In the vicinity of urban areas, it is becoming difficult to locate sufficient available land for this purpose. If the distance from the treatment facility to the landfill site is very great, landfilling can be a relatively expensive disposal technique and transportation energy demands would be high. If trucks are required for transportation, the resultant air pollution would be an environmental liability.

8. System Selection

For the ultimate disposal of solids, the MSDGC has adopted and is implementing a policy of solids-on-land disposal which entails the returning of all stabilized solid waste material back to the land. This method is deemed most consistent with processes occurring in nature. An alternative to land application is the disposal of digested and dewatered, or composted, or incinerated sludge in a properly located and operated sanitary landfill. The soil absorbs oils and sludges and furnishes an extended surface for microbial attack on the wastes.

The results of an engineering and econmic analysis favored processing the solids generated in the Northwest Region of the MSDGC at a central facility. The John Egan Water Reclamation Plant, in the Salt Creek Basin to the west of this project area, has been chosen as the sludge processing facility. Here sludge will be thickened and digested prior to land application.

Solids from the O'Hare plant will be transported by an 18 inch pipeline to the Egan facility. Three alternate routes were evaluated for the pipeline:

a) Oakton Street to Arlington Heights Road to Cosman Road to the Cook County Forest Preserve to Rohlwing Road to the Salt Creek Water Reclamation Plant.

b) Oakton Street to Higgins Road to Rohlwing Road to the Salt Creek Water Reclamation Plant.

c) Oakton Street to Busse Road to Touhy Avenue to Elk Grove Boulevard to J. F. Kennedy Boulevard to Biesterfield Road to I-90 to Rohlwing Road to the Salt Creek Water Reclamation Plant.

Alternate A included a sub-alternate through the Cook County Forest Preserve along the Salt Creek outfall sewer. Alternate C included two sub-alternates, (1) Bisner Road from Biesterfield Road to Cosman Road and (2) Arlington Heights Road from Biesterfield Road to the Cook County Forest Preserve.

After the examination of all incoming utility information and contacts with the Cook County Forest Preserve District, it was determined that Alternate A was the preferred alignment for the following reasons:

1) 31,365 feet length versus 33,400 feet for Alternate B and 37,500 feet for Alternate C.
2) Excessive surface restoration connected with Alternate C due to completely developed residential areas along John F. Kennedy Boulevard and Touhy Avenue.
3) Almost unobstructed alignment presented by the joint use of a planned MSDGC sewer easement along Oakton Street. This easement would be along the north property line of Oakton Street from Wildwood Road to Busse Road.

The sub-alternate through the Cook County Forest Preserve along the existing Salt Creek Outfall Sewer was eliminated because the additional investigation by the MSDGC indicated a problem in acquiring the right-of-way for the extreme easterly 2,300 foot portion of the heavily wooded area.

The existing anaerobic digestion facilities under construction at the John E. Egan WRP will have sufficient capacity to handle projected sludge production quantities for the year 2000. Following this system, two ultimate disposal modes were investigated. System 1 was based on centrifugation of the digested sludge with landfill disposal within 25 miles of the plant site. System 2 was based on the same centrifugation assumptions with ultimate disposal as dry fertilizer. Centrifugation as a means of mechanical dewatering at the John Egan WRP is based on pilot studies recently conducted by the MSDGC on alternate dewatering systems at the Hanover Park WRP. Pages M-25 - M-27 present a summary of the cost analyses of the alternative disposal systems in combination with the sludge stabilization system recommended for the John Egan WRP. Final disposal will be either to a landfill or by hauling and spreading on land as a fertilizer. No decision has yet been made with respect to final disposal.

TABLE M-IX-33 JOHN E. EGAN AND O'HARE WRP SOLIDS DISPOSAL SYSTEM

Planning Period: 25 years

Average solids production during planning period: 58.3 dt/d

Maximum solids production during planning period: 76.7 dt/d

Stabilization system Sta 1 - Anaerobic digestion at J. E. Egan Water Reclamation Plant

Present Worth Costs @ 5-7/8%:

A.	18" diameter sludge pipeline between O'Hare to J.E. Egan Water Reclamation Plant, 50-year life	$2,075,800
B.	Construction Costs	74,400
C.	Total Capital	$2,150,200

Annual Costs @ 5-7/8%

A.	Amortized Capital	$ 166,300/yr.
B.	M & O - Pumping Station	$ 10,400/yr.
C.	M & O - Anaerobic Digestion	$ 472,100/yr.
D.	Total Annual Cost	$ 649,100/yr.

TABLE M-IX-34 JOHN E. EGAN AND O'HARE WRP's SOLIDS DISPOSAL ALTERNATIVES

Planning Period: 25 years

Average digested solids production during planning period: 43.7 dt/d

Maximum digested solids production during planning period: 57.4 dt/d

Disposal System: D1 - Landfill within 25 mile radius

Present Worth Costs @ 5-7/8%:

A.	2 centrifuges in 1975	$	270,000
B.	3 centrifuges in 1985	$	228,825
C.	3 centrifuges in 1995	$	80,595
D.	Additional Flotation-Concentration Tanks	$	808,500
E.	Total Capital	$	1,387,900

Annual Costs @ 5-7/8%:

A.	Amortized Capital	$	108,000/yr.
B.	M & O (centrifuges)	$	421,000/yr.
C.	M & O (transportation)	$	570,300/yr.
D.	Total Annual Cost	$	1,099,300/yr.

Disposal System: D2 - Dry fertilizer application within 25 mile radius

Present Worth Costs @ 5-7/8%:

A.	2 centrifuges in 1975	$	270,000
B.	3 centrifuges in 1985	$	228,800
C.	3 centrifuges in 1995	$	80,200
D.	Additional Flotation-Concentration Tanks	$	808,500
E.	1,580 acres of land	$	593,000
F.	Application equipment	$	3,160,000
G.	Grading	$	2,120,000
H.	Total Capital	$	7,260,900

TABLE M-IX-35 SUMMARY OF THE JOHN E. EGAN WATER RECLAMATION PLANT SOLIDS SYSTEMS ($/YR.)

Sta-1		
CAP	$166,300	$166,300
M&O	482,800	482,800
D-1		
CAP	108,000	--
M&O	991,300	
D-2		
CAP	--	527,200
M&O		1,145,300
TOTAL CAP.	$ 274,300	$ 693,500
TOTAL M & O	$1,474,100	$1,628,100
TOTAL	$1,748,400	$2,321,600

APPENDIX N

Design Criteria O'Hare Reclamation Plant

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

Proj. No.: 67-300-2P
Page: 1 of 16
Date: 9/2/70
Proj.Engr.: F.K.
Rev.No.: 4
Rev. Date: 2-21-73

DESIGN CRITERIA

O'HARE WATER RECLAMATION PLANT

1.0 SCOPE

This document describes the basic engineering criteria for the installation of a Water Reclamation Plant to serve the O'Hare Area in the northwest section of the MSDGC. The northern and southern boundaries of the area follow Cook County boundary lines. The eastern boundary extends from Lake County south along Des Plaines River to the intersection of Rand and River Roads, thence in a southwesterly direction along the Chicago and Northwestern Railway to DuPage County line. The western boundary separates the service areas of the O'Hare and Salt Creek water reclamation plants, and generally follows along the ridge line dividing the Salt Creek and Des Plaines River drainage areas.

Present land use is predominantly residential with a degree of commercial activity normally associated with residential areas. The proportion of industrial development is considerably below the average for the Metropolitan Chicago area.

Effluent quality will meet or exceed the requirements of all applicable water quality and effluent criteria officially adopted by the Illinois Pollution Control Board (IPCB) on March 7, 1972.

2.0 TECHNICAL JUSTIFICATION

The O'Hare Area consists of 31,400 acres of residential-commercial and industrial development, and 5850 acres of rural or otherwise unsewered areas, a total of 37,250 acres. The 1970 census reflected a population of 223,000 for the entire O'Hare Service Area.

The first construction phase (Phase I) will be designed for an average dry weather flow of 72 MGD. It is projected that this flow will be attained by 1988 and the service area population will be 410,000. The ultimate population in the service area is projected to be 439,000 and will occur approximately by the year 2000. The ultimate average dry weather flow, which will occur sometime after the ultimate population is attained because of a projected slight incremental increase in per capita wastewater contribution with time, is estimated to be in the range of 90 to 96 MGD. Therefore, space and engineering design considerations will be provided to permit the construction of at least an additional 24 MGD of treatment capacity. The actual construction scheduling and size of the necessary additional treatment capacity will be governed by future conditions in the service area.

3.0 PROCESS REQUIREMENTS

3.1 Process Description

3.1.1 The design of the O'Hare Wastewater Reclamation Plant shall initially proceed as a two-stage activated plant providing for biological ammonia oxidation and meeting or exceeding all applicable IPCB effluent and stream standards at the average dry weather flow of 72 MGD. The effluent BOD and SS concentrations shall not exceed 4 mg/l and 5 mg/l, respectively, on the basis of 24-hour composite samples averaged over any consecutive 30-day period, and no more than 5% of the daily samples shall exceed 2.5 times the above numerical limits.

The secondary facility shall be designed so that it can be operated either as a two stage plant (i.e. series mode), or as two parallel activated sludge plants.

The hydraulic design and/or physical space shall be provided for the following facilities:

1. Phosphate Removal (chemical feed) facility.
2. Third stage (denitrification) facility.
3. The additional 24 MGD ADWF facility (Phase II).

Whenever possible, the Consultant shall specify identical equipment as installed in the Salt Creek and Hanover WRPs. The MSDGC shall furnish to the Consultant Contract Documents of the above facilities and other information regarding actual installed equipment as this information becomes available.

3.2 Population Data

3.2.1 Design population is 410,000

3.2.2 The design year is 1988.

3.2.3 The anticipated wastewater ADWF components, including infiltration, are:

Domestic and commercial	50.5 MGD
Industrial	21.5 MGD
Total	72.0 MGD

3.3 Flow Conditions will be as follows:

3.3.1 Average Dry Weather Flow .... 72 MGD

3.3.2 Maximum Dry Weather Flow ....110 MGD

3.3.3 Hydraulic Capacity (Phase I)........144 MGD

3.3.4 Ultimate Hydraulic Capacity ....192 MGD

3.4 Equipment and Facilities

3.4.1 Raw sewage pumps will be provided under Section 4.0. Variable speed pump driving mechanisms, computer controlled by elevations in the influent sewer and by flow control, will be provided.

3.4.2 Raw waste screening equipment will be provided.

3.4.2.1 Inclined coarse bar screens, mechanically cleaned with 2-inch clear opening between bars will be used.

3.4.2.2 Inclined fine bar screens, mechanically cleaned, 5/8-inch clear opening between bars will be used.

3.4.2.2.1 Facilities will be provided for one week's storage of screenings, grit and scum to allow for transportation interruption.*

3.4.3 Grit Chambers will be provided. The design of this facility shall be the Consultant's responsibility. However, the following shall be provided:

3.4.3.1 Grit will be moved by conveyor to a receiving area to be trucked away.

3.4.3.2 Flow Conditions (See Paragraph No. 3.3)

3.4.4 Aeration Tanks

The first and second stage aeration tanks will be designed as follows:

3.4.4.1 Displacement:
Wastewater Flow at 72 MGD-hrs...4.58 (approx.)
Wastewater Flow at 110 MGD-hrs...3 00 (approx.)

3.4.4.2 BOD loading @ 72 MGD-(first stage) lbs/1,000 C.F./day.......47 (approx.)

3.4.4.3 Water depth - feet ......16 (approx.)

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*The anticipated quantities, physical properties, proposed method of material handling and ultimate disposal of the materials are included in a report prepared for the MSDGC by Havens & Emerson. A copy of this report shall be furnished to the O'Hare WRP Consultant.

3.4.4.4 The Consultant shall recommend the number of tanks and the number of passes per tank for each stage.

3.4.4.5 Capability of operation as conventional and step aeration will be provided.

3.4.4.6 Conduits will provide for 100% return sludge based on 72 MGD.

3.4.4.7 Air requirements at 72 MGD, firm capacity, will be 1000 cu ft/lb. BOD removed (first stage aeration). Consultant will determine air requirements for the second aeration stage.

3.4.4.8 Diffuser plate will be 60 to 80 permeability.

3.4.4.9 Each aeration tank pass will be automatically controlled by means of DO probes with a provision for remote manual operation.

3.4.4.10 Air will be controlled to each plate header by manually operated valves.

3.4.4.11 Provision for liquid chemical storage and feed equipment for phosphate removal will be made for each stage (front and end).

3.4.5 Final Sedimentation Tanks

First and second stage final tanks will be designed as follows:

3.4.5.1 Surface Settling rates (gal/ft^2/day) at 72 MGD .... 640 (approx.)

3.4.5.2 Sidewall depth (feet).... 15 (approx.)

3.4.5.3 Center feed and annular effluent arrangement shall be provided. Weir overflow rate shall not exceed 15,000 gal/day/ft at 72 MGD. V-notched weirs will be used.

3.4.5.4 Sludge collecting mechanism types:
First stage .... Plow type.
Second stage ...... The Consultant shall provide two alternate sludge collector designs for the second stage settling tanks. The two alternate sludge collectors shall be plow type and suction type.

3.4.5.5 Air lift for sludge pumping will be provided.

3.4.5.6 Scum removal mechanism will be provided in each stage.

3.4.5.6.1 Scum will be piped to ejector and then to screen building. A scum dewatering facility will be provided.

3.4.6 Tertiary Filter - The filter will be mixed media type and be designed as follows:*

3.4.6.1 Filter depth - (feet) 3.5
3.4.6.2 Filter rate @ 110 MGD (GPM/SF) 5
3.4.6.3 Capability shall be provided to recycle filter backwash water to the wet well and the head end of the second stage aeration tanks.

3.4.7 Chlorination Facility

3.4.7.1 Chemical feed equipment shall be provided.

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*Additional study will be made on filter recycle. The size of the clear well will be determined from this study.

3.4.7.2 Sodium hypochlorite will be used.

3.4.7.2.1 Ability to dose in the range of 0 to 10 ppm will be provided for secondary and tertiary sewage.

3.4.7.2.2 Sodium hypochlorite feed will be controlled by effluent flow and chlorine residual analysis.

3.4.7.2.3 Three week storage facilities on basis of 1.5 ppm dosage will be provided.

3.4.7.3 Provision for dosing before and after filtration will be made.

3.4.7.4 A chlorine contact chamber, based on 15 minute detention time at 144 MGD will be provided downstream of filters.

3.4.8 Sludge Transfer Facilities

3.4.8.1 No sludge thickening or storage facilities will be provided.

3.4.8.2 Sludge transfer sump will be located in the screen room of the pump building.

3.4.8.3 Sludge transfer pumps including standby pump will be provided to pump the waste activated sludge.

3.4.8.3.1 Operation of the pumps will be regulated automatically by the level of the sludge in the sump.

3.4.8.3.2 Pumping capacities and head requirements shall be specified by the O'Hare WRP Consultant upon conferring with the MSDGC force main consultant. The meetings between consultants shall be coordinated by the MSDGC.

4.0 MECHANICAL REQUIREMENTS

The following mechanical facilities and equipment will be provided:

4.1 Centrifugal type blowers
  4.1.1 Blower air surge protection
  4.1.2 Bag type air filters with roll type filter as back-up system.
4.2 Raw sewage pumps (see Section 3.4.1)
4.3 Effluent water supply system
4.4 Potable water supply system
4.5 Dual fuel system (i.e. natural gas and oil) for space heating
4.6 Air conditioning equipment, etc. for office and control area.
4.7 Building heating system
4.8 Plumbing, water heaters, etc.
4.9 Intake ductwork for fresh air and seasoned temperature control.

NOTE: Projection of equipment above tanks shall be held to a minimum.

5.0 STRUCTURAL REQUIREMENTS

5.1 Reinforced concrete - pump and blower house, screen house, grit chamber, aeration tanks, settling tanks, clear well, connecting conduits, channels, manholes and miscellaneous structures.

5.1.1 Air main to be constructed in concrete tunnel which will also contain other utility services where feasible.

5.2 Filter building and administration building.

5.3 Entrance road, parking area, and miscellaneous plant roads and walkways. Plant entrance shall be on Oakton Street.

5.4 Garage building will be provided which will include area for:

- 5.4.1 Maintenance equipment storage.
- 5.4.2 Underground gasoline storage exterior to Garage Building.
- 5.4.3 Commodity storage
- 5.4.4 Small work shop
- 5.4.5 Storage of equipment for lifting heavy materials.

6.0 ELECTRICAL REQUIREMENTS

6.1 Major process equipment will be motor driven.

6.1.1 Major motors will operate on 480 volt, 3 phase, 60 Hertz, 3-wire ungrounded for motors less than 200 H.P. For motors of 200 H.P. or higher, the power service will be 4160 volt, 3 phase, 60 Hertz, 3-wire ungrounded.

6.1.2 All electrical equipment shall be grounded.

6.2 Plant lighting (exterior and interior) will be included.

6.3 Wiring for automatic and remote control of equipment and instruments will be provided.

6.4 All wiring will be in rigid conduit in tunnel or underground in cable duct.

6.5 There shall be two separate sources of electrical power provided by Commonwealth Edison Co. to the plant

6.5.1 There shall be a third source of electrical power by means of a power-generating system at the plant. This system shall be independent of any utility company and shall supply only emergency power for the process control system, instrumentation, critical process equipment and emergency lighting.

7.0 INSTRUMENTATION REQUIREMENTS

7.1 Automation and instrumentation, as complete as present technology permits, will be provided for both on line plant control as well as preventive maintenance detection.

7.1.1 Instrumentation will include, but not be limited to, flow control, chemical feed control, sludge level control, automatic D.O. control, wet well level control, automatic backwash of filters, remote sluice gate operation and turbidity monitoring.

7.2 Automatic sampling will also be provided.

8.0 ARCHITECTURAL REQUIREMENTS

8.1 Exterior of buildings will be compatible with surrounding area.

8.2 Where feasible, utility services will be placed in tunnel sections.

8.3 Sound insulation will be provided in buildings, where required, as protection from noise caused by low-flying aircraft.

8.4 Landscaping of the entire plant site will be included.

8.5 A minimum 150-foot isolation strip with dense vegetation for plant protection will be provided along Oakton Street, Elmhurst Road and Marshall Drive. The width of the isolation zone along the MSDGC property line bordering the Northwest Tollway shall be left to the recommendation of the

Consultant.

8.6 Plant layout shall include provision for future modules and expansion of all facilities.

8.7 Plant layout shall include first-aid and safety room.

8.8 Higgins Creek will be rerouted and enlarged within the plant site. The maximum capacity of the creek will be 1207 cfs. The creek invert elevations in and out of the plant site are 648.4 and 645.7 (MSL-1929 adj.), respectively. Compensatory storage in accordance with the MSDGC's Sewer Permit Ordinance and Suggested Guidelines for Flood Damage Prevention shall be provided for in the MSDGC's Ravenswood Retention Reservoir.

8.9 Handrails shall be provided for all open tanks which can constitute a safety hazard. This requirement includes, but is not limited to, aeration and settling tanks.

8.10 All architectural materials shall be specified in the plans and/or specifications by name and color. This requirement shall include, but not limited to, office furniture, carpeting, drapes, shop benches.

9.0 ENVIRONMENTAL REQUIREMENTS

9.1 An "Environmental Assessment Statement" will be prepared for submission to the U.S. Environmental Protection Agency.

10.0 MATERIALS AND SERVICES PROVIDED BY OTHERS

10.1 Soil Borings by Construction Division.

10.2 Survey by Administration Division.

10.3 Water table observations by Construction Division.

11.0 CONSTRUCTION CONSIDERATIONS

11.1 Plant construction will have to run concurrent with sewer construction so that plant can be tested and put in operation on completion of construction. The O'Hare WRP and sewer Consultants will have to coordinate their engineering design activities in order to arrive at compatible systems.

12.0 GOVERNING CODES AND STANDARDS

12.1 MSDGC Standards, where applicable, shall be used throughout the engineering work. In particular, the requirement of stainless steel for handrails, doors, etc. shall be included in the Contract Documents.

12.2 Wherever applicable, the latest revisions of the codes, standards, and the recommended practices of the following organizations shall govern the design, construction, installation, inspection, and testing of all work and materials:

12.2.1 Institute of Electrical and Electronics Engineers (IEEE).

12.2.2 National Electrical Manufacturer's Association (NEMA).

12.2.3 National Electrical Code (NEC).

12.2.4 Insulated Power Cable Engineers Association (IPCES)

12.2.5 American Society of Mechanical Engineers (ASME)

12.2.5.1 American National Standards Institute (ANSI)

12.2.6 American Society of Testing and Materials (ASTM)

12.2.7 American Water Works Association (AWWA)

12.2.8 American Welding Society (AWS)

12.2.9 American Institute of Steel Construction (AISC)

12.2.10 American Concrete Institute (ACI)

12.2.11 Chicago Building Code

12.2.12 Illinois Division of Highways (IDH)

12.2.13 Instrument Society of America (ISA)

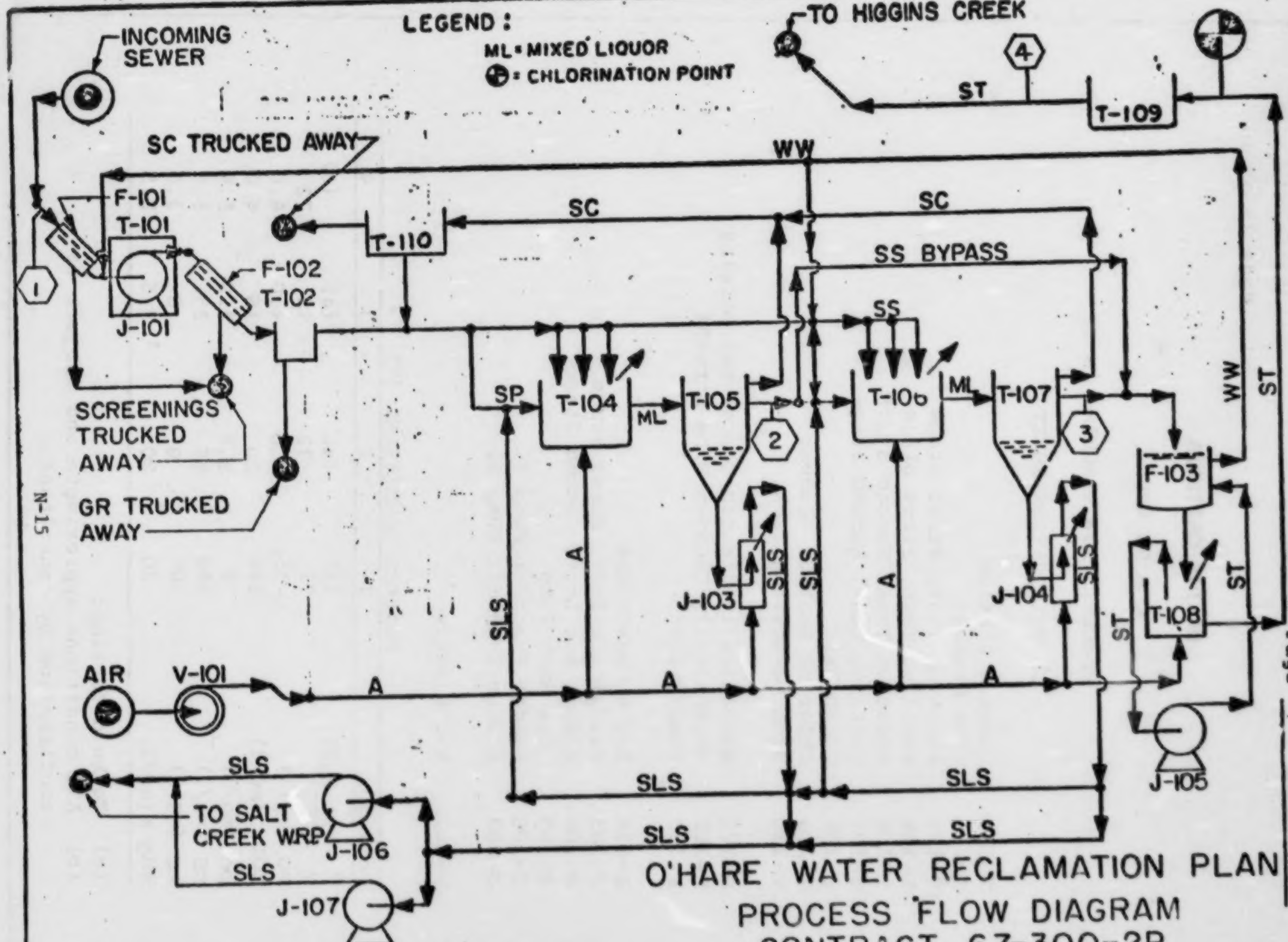
12.2.14 Metropolitan Sanitary District of Greater Chicago (MSDGC)

12.2.15 Occupational Safety and Health Act (OSHA)

13.0 REFERENCE DATA

13.1 Process Flow Diagram Drawing PF-1 (attached)

13.2 Design Report, O'Hare Water Reclamation Plant, June 1968, by Brown and Caldwell, Consulting Engineers.


INCOMING SEWER
LEGEND:
ML = MIXED LIQUOR
⊕ = CHLORINATION POINT
TO HIGGINS CREEK
4
ST
T-109
SC TRUCKED AWAY
WW
SC
SC
SS BYPASS
F-101
T-101
J-101
1
T-110
F-102
T-102
SS
SP
T-104
ML
T-105
2
T-106
ML
T-107
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F-103
WW
ST
SCREENINGS TRUCKED AWAY
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A
SLS
J-103
SLS
SLS
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J-104
SLS
T-108
ST
ST
AIR
V-101
A
A
A
J-105
SLS
SLS
SLS
SLS
SLS
TO SALT CREEK WRP
J-106
SLS
J-107

O'HARE WATER RECLAMATION PLAN
PROCESS FLOW DIAGRAM
CONTRACT 67-300-2P

Flowsheet intended to be descriptive.
Final details and accuracy to be responsibility of consultant.

DESIGN CRITERIA

O'HARE WRP

PROCESS FLOW DIAGRAM

IDENTIFICATION SHEET

T-101	Pumping Station
T-102	Grit Chamber
T-104	Aeration Tank, First Stage
T-105	Settling Tank, First Stage
T-106	Aeration Tank, Second Stage
T-107	Settling Tank, Second Stage
T-108	Clear Well
T-109	Chlorine Contact Chamber
T-110	Scum Dewatering Tank
F-101	Mechanically Cleaned Coarse Bar Screens
F-102	Mechanically Cleaned Fine Screens
F-103	Sand Filter
J-101	Raw Sewage Pumps
J-103	Sludge Air Lift, First Stage
J-104	Sludge Air Lift, Second Stage
J-105	Back Wash Pump
J-106	Sludge Transfer Pump #1
J-107	Sludge Transfer Pump #2
V-101	Air Blowers

PROCESS CONDITIONS [(b)]

Position	1	2	3	4
P (Ft H_2O)	(a)	(a)	(a)	(a)
F (MGD)	72	72	72	72
PO (mg/l)	5-15	4.0	4.0	4.0
BOD_5 (mg/l)	146	20	15	4.0
DO (mg/l)	0	2.0	2.0	5.0
SS (mg/l)	180	25	25	5.0
RC (mg/l)	0	0	0	1.0
NH_3-N (mg/l)	20	20	2.5	2.5

(a) To be determined

(b) All conditions approximate and subject to confirmation by consultant.

Variakojis

John Variakojis
Engineer of Process Planning

Robert Barbolini

Robert R. Barbolini
Assistant Chief Engineer

Forrest C. Neil

Forrest C. Neil
Chief Engineer

Raymond R Rimkus

Raymond R. Rimkus
Acting Chief of Maintenance and Operations
Approved as to Maintenance and Operations

C. Lue-Hing

Dr. Cecil Lue-Hing
Director of Research and Development
Approved as to Research and Development

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

ADDENDUM NO. 1 of REV. NO. 4 (2/21/73)
April 10, 1973

ADDENDUM NO. 1
DESIGN CRITERIA DOCUMENT
O'HARE WATER RECLAMATION PLANT
PROJECT 67-300-2P

PAGE	SECTION	REVISION
11	8.8	Delete paragraph and add: Higgins Creek will be rerouted and enlarged within the property to accomodate plant effluent and upstream storm runoff. The Contract Documents shall be prepared so that alternate bids are submitted with and without compensatory surface storage on plant site.

John Variakojis
John Variakojis
Supervising Engineer

Robert Barbolini
Robert R. Barbolini
Assistant Chief Engineer

Hugh McMillan
Hugh McMillan
Acting Chief Engineer

Raymond R Rimkus
Raymond R. Rimkus
Acting Chief of Maintenance and Operation
Approved as to Maintenance and Operation

C. Lue-Hing
Dr. Cecil Lue-Hing
Director of Research and Development
Approved as to Research and Development

(1-4) will be maintained so as to be competitive in the locality. All data submitted shall be carefully analyzed to determine acceptability of the system and its operation. For guidance refer to Reference 1 of the Foreword. During the preliminary planning stage it shall be determined that all details of the proposed system are acceptable. Complete final drafts of all legal documents pertaining to the organizational structure of ownership and operation of the system shall be secured. During the final planning stage it shall be determined that the permanent organization for owning and operating the system is acceptable as evidenced by copies of all recorded documents pertaining thereto.

i. Sewage Treatment Plants. Residential properties located close to the site of a sewage treatment plant may be adversely affected in marketability. There are times when odors may be expected, if the plant is overloaded or not operated in an efficient manner. The direction of the prevailing breeze appears not to be of major significance since objectionable odors may be more noticeable when the air is still. Topography, trees or undergrowth may be helpful. However, the best means of assuring protection against possible odors is to provide adequate space between the residential properties and the sewage treatment plant.

(1) Due to the variety of types of sewage plants as well as the variations in size, topography, and climate which may be encountered, the advice of the Sanitary Engineer should be obtained in determining the proper location for the treatment plant for all except the very small and simple installations.

(2) The distance from sewage treatment plants at which locations would be eligible for mortgage insurance varies. When the local Health Authority requires a minimum isolation distance, it is generally established on the basis of potential health hazards to the occupants. Since HUD-FHA must consider many other factors, HUD-FHA's minimum is sometimes in excess of that minimum distance established by the Local Health Authority, but in no case will it be less. This situation is no different from that encountered where HUD-FHA Minimum Property Standards exceed local codes. If local codes or Health Department requirements exceed HUD-FHA requirements, then HUD-FHA would, of course, require that the higher standards be met.

(1-4) j. Isolation Distances. If the odors arising from sewage treatment plants are objectionable and affect the desirability and marketability of homes at a greater distance than that prescribed for reasons of health, HUD-FHA would necessarily have to establish a higher minimum. The adequacy of the sewer system, type of sewage treatment, topography, natural or artificial screening, seasonal weather and wind conditions are all important factors to which HUD-FHA must give careful consideration in determining isolation distances. Since these conditions vary widely, HUD-FHA cannot establish isolation distances in an arbitrary manner. Each individual situation must be carefully studied and a decision made based on all the facts surrounding that particular case.

k. Distance and Value. The underwriting problems introduced by sewage disposal plants are no different than those problems introduced by other types of nuisances which produce smoke, noxious odors, offensive noises or unsightly neighborhood features. Within certain distances, the adverse affect of these conditions is so great that the location would be unacceptable. Beyond this point, acceptability of the location could be established, but in all likelihood values in relation to cost would be impaired. As the distance from the nuisance increases, progressively higher values in relation to cost would logically follow. Only findings derived from an analysis based on a complete comprehension of this approach can be logically supported.

(1) Sound underwriting must recognize the fact that HUD-FHA does not arbitrarily establish a line having a reject area on one side and an acceptable area on the other wherein property values are not impared.

(2) It is the responsibility of the Valuation Section to reflect the intensity of the conditions as the properties recede from the nuisance.

l. Individual Water and Sewerage Systems. Other conditions being equal, market acceptance is restricted when individual water-supply and sewerage-disposal systems are installed in a new subdivision when competitive areas in the community are, or can be, served by acceptable public or community systems. Water supply and sewerage disposal sometimes can be provided by individual systems on each property within a subdivision. However, individual water-supply systems are

(5-6) The location of the shopping center should be for the greatest convenience of the greatest number of patrons. Usually the site selected should be directly accessible from an arterial or collector street with adequate provision for off-street parking and delivery services. It has been a common speculative error to locate too many shopping centers too close together and with more land than needed, thereby creating unfavorable influences upon adjoining neighborhoods as well as resulting in unsuccessful commercial ventures.

f. School Sites. Based on data supplied by school authorities, school sites should be adequate in size for present and anticipated needs. They should be conveniently located and have ample provision for vehicular parking space to avoid interference with the parking [illegible]

g. Parks and Playgrounds. When large undeveloped areas adjoin a subdivision the need for parks and playgrounds is not always recognized. Future needs should be anticipated, and the difficulty and expense of procuring necessary space for parks after the area has been densely developed should be foreseen. Parks and properly located playgrounds are a definite asset to neighborhoods, providing a safe place for outdoor play and recreation. Rough wooded areas that are difficult to develop into economical dwelling sites are often well adapted for park purposes. Furthermore, the provision of parks and playgrounds usually benefits not only the user, but the developer as well through the enchancement in values of his properties. HUD-FHA encourages local authorities in the establishment of these community facilities where appropriate.

h. Sewage Treatment Plants. In addition to sanitary engineering considerations, care should be exercised in selecting the site for a sewage treatment plant. Residential properties should be located so that they will not be adversely affected from an aesthetic standpoint or by reason of possible odors. There are times when odors may be expected if the plant is over-loaded or not operated in an efficient manner or a sewage lagoon system is used. The direction of the prevailing breeze appears not to be of major significance since objectionable odors may be more noticable when the air is still. Topography, trees or undergrowth may be helpful. However, the best means of assuring protection against possible odors is to provide adequate space between the residential properties and the sewage treatment facility.

REC'D FM
HUD CHICAGO
1-20-75

615-9 SEWAGE DISPOSAL SYSTEM

615-9.1 General

a. Provide each living unit with a water-carried sewerage system adequate to dispose of all domestic wastes in a manner which will not create a nuisance, contaminate any existing or prospective water source or water supply, or in any way endanger the public health.

b. Whenever feasible, connection shall be made to a public sewerage system.

c. When a public system is not available or connection thereto is not feasible, connection shall be made to a community system, if feasible. Such system shall comply with 4940.3. All privately owned central or community sewerage systems shall be approved by the state health and pollution control authorities and the local health department.

d. When service from an acceptable public or community sewerage system is not available or feasible, and ground water and soil conditions meet the requirements of this standard, an individual system may be accepted by HUD provided it is installed in accordance with the requirements contained herein.

e. Any system of individual sewage disposal which is acceptable herein but which is not permitted by the local health authority having jurisdiction shall not be used. Evidence of approval by such authority for each completed system will be required in all cases. ✓

615-9.2 Individual Sewerage Systems - General

a. No part of the system shall be installed closer to other features of the property than the minimum distances shown in Table 6-15.5.

b. Installation of individual systems in swampy areas, areas with a high water table (permanent, fluctuating or seasonal), areas with ledge rock or areas which are subject to flooding is not acceptable.

CS100 OBJECTIVE

To provide each living unit with a water-carried sewerage system adequate to collect, treat and dispose of waste water in a manner which will not create nuisances or endanger the public health.

CS200 GENERAL ACCEPTABILITY

✓

CS201 LOCAL CODES AND REGULATIONS

CS201-1 The minimum standards set forth herein have been established to accomplish certain basic HUD-FHA objectives and shall not be construed as relieving the builders of responsibility for compliance with local ordinances, code and regulations including established requirements of a health authority having jurisdiction.

CS201-2 HUD-FHA does not assume the responsibility for enforcing or determining compliance with local codes or regulations or making interpretations regarding their application in any specific instance.

CS201-3 Where the local code, regulation or requirement permits lower standards than required herein, these Minimum Design Standards shall apply. In the event, the local code, regulation or requirement precluded compliance with these standards, the property must be ineligible unless the stated objectives set forth herein are fully attained by the alternate means proposed.

CS202 REVISIONS TO APPROVED PLANS

Any deviations from the approved plans or specifications must be approved in writing by the appropriate Field Office before such changes are undertaken. A re quest for such approval shall be accompanied by written evidence that the proposed changes are acceptable to the State Department of Health and any other state or local authority having jurisdiction. The request shall also be accompanied by a supplementary engineer's report describing the changes and the reasons for them.

CS510 FORCE MAINS

CS510-1 Velocity

A design average flow velocity in excess of two feet per second shall be maintained.

CS510-2 Air Relief Valve

Where necessary an automatic air relief valve shall be placed at high points in the force main to prevent air locking. Where possible the force main shall pitch continuously upward avoiding any high points in the line.

CS510-3 Termination

Force mains should enter the gravity sewer system at a point not more than two feet above the flow line of the receiving manhole.

CS511 POWER SUPPLY

Power supply should be available from at least two independent generating sources, or emergency power equipment should be provided. Where this is not feasible, an overflow should be provided at such an elevation as to prevent basement flooding or back water from stream affecting operation. Where power failure would result in objectionable conditions because of the resultant discharge or basement flooding, means for emergency operation shall be provided.

CS600 SEWAGE TREATMENT WORKS

CS601 PLANT LOCATION

In general to avoid local objections a sewage treatment plant site should be as far as practicable from any present built-up area or any area which will probably be built up within a reasonable future period. If a critical location must be used, special consideration must be given to the design and type of plant provided. Plants should be located at an elevation which is not subject to flooding or else be adequately protected against flood damage. The plant should be readily accessible in all seasons.

REC'D FM
MR. WANER
2-18-75

CHAPTER 2. LOCATION ANALYSIS

2-1. PURPOSE OF LOCATION ANALYSIS. The purpose of Location Analysis is to identify the characteristics of location which affect the value and economic life of a specific property.

2-2. GENERAL. The analysis of location requires a determination of desirability and utility of the site and the degree and extent to which the site, by reason of its environmental influences, shares in the market for comparable and competitive sites in the community. The analysis of location involves a forecast of the changes likely to be experienced at the site due to probable future trends in addition to an appraisal of the present situation. A knowledge of the trends which affect the valuation of real property is necessary to properly analyze the location. The principle of change is fundamental to real estate appraising and to the analysis of a location. Value is created and modified by economic, social and governmental changes which occur outside of the property itself. It is necessary to predict the direction of the trend and determine the future effect it will have on property values.

2-3. COMPETITIVE LOCATIONS. Locations are construed to be competitive when they are improved with, or appropriate for, residential properties that are approximately similar in accommodations, and are within a sales price range or rental range that proves acceptable to typical residents or prospective occupants.

2-4. THE METHOD OF ANALYSIS. The analysis of location is accomplished through the consideration of the features hereinafter discussed. Each feature of the location is compared with the same feature of competitive locations in the community. An acceptable location must be related to the needs of the prospective occupants and to the alternatives available to them in other competitive locations.

2-5. CONSIDERATION IN THE ANALYSIS OF LOCATION. In the analysis of location, no cognizance is taken of the character or quality of the building improvements which exist on the site or which are proposed in the application for mortgage insurance. A vacant site will, therefore, have the same location evaluation of quality as an improved site under similar environmental influences.

2-6. ECONOMIC TRENDS. Consideration must be given to economic trends of the nation, region, community and the neighborhood, such as:

a. Industrial, commercial, agricultural and retail sales activity.

b. Price and wage levels - purchasing power of individuals.

c. Employment.

d. Supply and demand of living units.

e. Taxation levels.

f. Mortgage interest rates.

g. Building Costs.

h. Population change.

i. Activity in the real estate sales market.

2-7. LAND USES. Location Analysis involves a determination of the effect of actual and potential neighborhood land uses upon the subject location. A location which contains the proper balance of land usage such as residential, commercial, parks, schools, and playgrounds enhances the value and the economic security of a property. The following are factors which form the pattern for present and future land uses:

a. Zoning. Appropriate and well-drawn zoning ordinances which receive public approval and are strictly enforced will provide one of the best means of protecting residential locations from adverse influences that diminish the desirability of sites.

b. Protective Covenants. Properly drawn protective covenants have proved more effective than zoning ordinances in providing protection from adverse environmental influences; and, when combined with proper zoning, provide maximum legal protection to assure that a developed residential area will maintain desirable characteristics, or that a proposed, or partially built-up neighborhood will develop in a desirable manner. The protective convenants should be superior to any mortgage and should be binding on all parties and all persons claiming under them.

c. Identification of Inharmonious Land Uses. Inharmonious land uses in the neighborhood must be identified. The present and long term effect such uses will have on the market value and economic life of the subject property must be defined. The market value and remaining economic life must reflect these influences. In situations where the inharmonious land uses represent a serious detriment to either the health or safety of the occupants or to the economic security of the property, the application for mortgage insurance must be rejected.

2-8. PHYSICAL AND SOCIAL ATTRACTIVENESS. The features listed below are analyzed to determine the physical conditions of the neighborhood that affect the physical improvements and the health and safety of the occupants or influence their pleasure in the appearance of the environment. The elements considered in this analysis are:

a. Special Hazards and Nuisances. Physical conditions may be found in some neighborhoods that are a hazard to the personal health and safety of the occupants or that may endanger the physical improvements. Such conditions include unusual topography, subsidence, flood, unstable soils, traffic hazards to health, and various kinds of grossly offensive nuisances.

(1) Topography. Special hazards are sometimes found to result from the peculiar topography of a neighborhood. Marketability is often adversely affected in hillside areas by the hazards caused by denuded slopes, soil erosion, and land slippages. Earth and mud slides from adjoining property, falling rocks, etc., are some of the hazards associated with steep grades and must be considered in the evaluation of the location.

CHECKMARKS
BY MR. WANER
2-18-75

(2) Subsidence. Danger of subsidence is a special hazard that may be encountered under a variety of circumstances. The danger may exist when buildings are constructed on uncontrolled fill or unsuitable soil containing foreign matter such as organic material. It may be present in certain areas where the sub-soil is unstable and subject to slippage or expansion. In mining areas consideration must be given to the depth or extent of mining operations, and the location of operating or abandoned shafts or tunnels in order to reach a conclusion as to

(2-8) whether the danger is imminent, probable, or negligible. In locations where the danger of subsidence exists, a specific site will be deemed ineligible unless complete and satisfactory evidence can be secured that will establish the probability that any threat of subsidence is negligible.

(3) Flood Hazard. In low lying areas or other locations subject to frequent periodic floods which cause serious property damage or danger to personal safety, the degree of risk will be considered too great to be acceptable.

(4) Heavy Traffic. Location on streets having heavy or fast traffic lessens desirability because of noise and danger and often affects the value. Sites backing to freeways or other thoroughfares which are heavily screened or where traffic is well below grade and sufficient distance from the property may not be adversely affected.

(5) Airports. Locations near an airport may be subjected to the noise and hazard of low-flying aircraft. The ever increasing volume of aircraft activity together with the use of jet aricraft has substantially increased the noise nuisance and potential hazards in locations near major airports. In the analysis of this feature consideration must be given to the desirability of an affected location in comparison with unaffected locations that are improved with or are appropriate for competitive structures.

CHECKMARKS
BY MR. WANER
2-18-75

(6) Fire and Explosion. The storage or manufacture of volatile or explosive products, and other conditions that constitute extraordinary exposure to the danger of explosion or conflagration from nearby industry, gas lines, or contiguous brush or grass land, are hazards that adversely affect value of the dwellings in the neighborhood.

(7) Smoke, Fume, Noise, Etc. Smoke, fog, chemical fumes, noxious odors, stagnant ponds or marshes, poor surface drainage and excessive dampness may exist to a degree that is hazardous to the health of neighborhood occupants. Offensive noises, odors and unsightly neighborhood features such as stables, kennels, and malfunctioning sewage disposal systems adversely affect the appeal of the neighborhood.

(2-8) (8) Sewage System Failure. Where individual sewage disposal systems are involved, an analysis of the location must be made to assure that the area is free from conditions which adversely affect the operation of the systems. Consideration will be given to the type of systems, topography, depth to ground water, soil permeability and the type of soil to a depth of several feet below the surface. A check of the other septic systems in the neighborhood must be made to assure that other failures within the neighborhood will not adversely affect the subject property. Whenever there are instances of doubt concerning the operation of sewage disposal systems in a neighborhood, the services of the Sanitary Engineer should be utilized.

b. Natural Physical Features and Landscaping. Few, if any, home owners are oblivious to favorable topographic and site features such as pleasing view, wooded lots, broad vistas, and climatic advantages. But some segments of the market will be more insistent in their demands for attractive neighborhoods than others. Attractive street layouts and preservation of natural attractiveness are characteristics of good neighborhood design. Areas in which streets have been laid out with proper regard to drainage, land contours and traffic flow increase the desirability of the neighborhood.

c. Attractiveness of Neighborhood Buildings. The appeal of a location is strengthened if the buildings in a neighborhood are attractive as a group and harmonize with one another, and with their physical surroundings. A pleasing variety that results in harmoniously blended properties without monotomous repetition is desirable. It has been demonstrated that pleasing variety in dwelling design need not be sacrificed in neighborhoods composed of low-cost housing.

d. Neighborhood Character. Mobility and economic growth have combined to alter neighborhood patterns. Shopping, recreation, places of worship, schools and places of employment are reached with comparative ease. The lessened disparity between income of professions and trades and of management and skilled labor has contributed to a mingling of such families in stable neighborhoods.

APPENDIX P

FACILITIES PLANNING STUDY

O'HARE WRP COST EFFECTIVE ANALYSIS

I. Summary

At the request of USEPA's Region V Office, the MSDGC's staff has conducted an economic analysis to determine the most cost effective plant size to be constructed in the O'Hare Facility Area. Specifically, the question was raised whether the construction of the presently propose 72 MGD facility could be economically justified. If the analysis were to show that a 48 MGD plant or some size intermediate between 48 and 72 MGD were to be optimal, then the USEPA and IEPA would fund only those costs attributable to the optimal size facility.

Because the rate of increase of future flows significantly influences the outcome of the analysis, a step by step derivation of forecasted flows is included in this study.

The economic analysis was performed using guidelines established by the USEPA.

The results of this analysis indicate that the most cost effective plant size is a 72 MGD plant to be constructed by 1978.

II. Derivation of Flows

In forecasting wastewater flows to be generated in O'Hare Facility Area, the following information is required:

a. Unit wastewater flow, Gallons Per Capita Per Day (GPCPD), based on sewer gaging records.

b. Projected rate of increase of sewage flow based on assessment of historical data and future events.

c. Projection of industrial flow.

d. Quantity of allowable infiltration.

A. Unit Wastewater Flow in 1970:

In 1970, flows from the O'Hare Service Area were measured and recorded at the Rand Road Sewer Gaging Station. These data indicated that average daily flow was 31.6 MGD.

Assumptions for computing GPCPD:

a. Total Population in O'Hare Facility in 1970 = 223,000

b. Sewered Population in O'Hare Facility Area in 1970 = 200,700

c. Average Dry Weather Flow = 95%(Measured Flow) = 30 MGD

Based on these assumptions, the unit wastewater loading in the O'Hare Service Area in 1970 was 150 gpcpd. This value includes contributions from Domestic, Infiltration and Industrial sources.

B. Rate of Increase of Sewage Flow:

In designing a sewage treatment facility it is often necessary to consider the future flows in terms of anticipated increases in population and per capita flows. However, it has been suggested by the USEPA staff that increase in per capita flow may not be valid for the O'Hare Facility Area. To determine whether this claim was valid, water consumption records for five communities situated in the O'Hare Facility Area were analyzed. It was reasoned that historical data would offer the most reliable information regarding trend and rate of flow increase for the near future.

1. Historical Data:

1a) Water Consumption in 1966:

Community	Per Capita Consumption (1)	Population (2)	Flow (MGD)
Des Plaines	126	48,000	6.048
Mt. Prospect	97	28,000	2.716
Arlington Hts.	69	50,000	3.450
Elk Grove Village	148	15,000	2.220
Wheeling	103	11,000	1.133
		152,000	15.567

GPCPD for all Five Communities = $\frac{15.567}{152,000}$ MGD = 102.43

1b) Water Consumption in 1970:

Community	Per Capita Consumption (3)	Population (4)	Flow (MGD)
Des Plaines	138	57,300	7.907
Mt. Prospect	97	35,000	3.395
Arlington Hts.	98	64,880	6.358
Elk Grove Village	131	24,500	3.210
Wheeling	91	14,600	1.329
		196,280	22,199

GPCPD for All Five Communities = $\frac{22.199}{196,280}$ MGD = 113.10

References and Bases:

(1) Based on "Report Upon Adequate Water Supply for the Chicago Metropolitan Area 1969 to 2000", by Alvord, Burdick & Howson

(2) Estimated population in 1966 based on census data of 1960 and 1970.

(3) Based on "Report on Water Supply for Northeastern Illinois1972-2000", by Alvord, Burdick and Howson.

(4) Estimated population based on 1970 census data.

Therefore, historical data between 1966 and 1970 show that rate of per capita increase including Domestic, Industrial and Infiltration flow equalled (113.1 - 102.43)/4 years = 2.667 GPCPD/year.

2. Future Considerations:

In addition to historical data, rate of increase of future flow must also be evaluated in light of such factors as industrial development, adequacy of water supply, and probable water usage habits of people within the O'Hare Facility Area. Assessment of these factors must by necessity be based on incomplete data and opinions. Nevertheless, these factors and their potential impact on future wastewater flows must be recognized and accounted for in designing the treatment facility.

MSDGC has assessed the foregoing factors mentioned and concluded the following:

2a) Industrial Development

The O'Hare Facility Area is adjacent to O'Hare Airport and is served by two major expressways as well as several railroads. Being bounded by established communities to the east and southeast, the labor market is excellent both in terms of skilled and unskilled workers. The Facility Area also has considerable amount of open space which can be used for industrial purposes. Thus, three key ingredients necessary for industrial development (transportation, labor market and land) exist in or near the Facility Area. Therefore, it is assumed that in the near future moderate to intense industrial development will occur within the O'Hare Facility Area.

2b) Adequacy of Water Supply

Presently, the City of Des Plaines is the only community served by the City of Chicago or Lake Michigan supply. Other communities located in the Facility Area are dependent upon wells which provide a limited but presently adequate supply. As communities expand, demand for more water will either force these communities to seek other sources or to curtail their growth. The most probable "other source" available to the communities in the west is the Lake Michigan water via the City of Chicago. Several reports have been prepared to date studying the feasibility of extending Lake Michigan water to the inland communities. These reports have recommended extension of Lake Michigan water supply as an action which would be mutually beneficial to the City of Chicago and the suburbs. Therefore, it is believed that in the future, an adequate water supply will be available to support continued growth in the O'Hare Facility Area.

2c) Water Usage Habits

The effects of this factor are difficult to assess because it requires subjective evaluation. Water Usage Habits reflect the society's so called lifestyle and is a function of among other elements, attitudes, economic state (income) and social strata. The MSDGC has addressed these factors and concluded that per capita flow will continue to increase in the future.

Based upon the conclusions drawn above, it is assumed that recent per capita increases as indicated by historical data will continue to occur in the O'Hare Facility Area. Furthermore, the future increases are assumed to occur in the following manner:

a) Domestic per capita flow will increase almost linearly reaching near maximum level around year 2000.

b) Industrial flow will increase in the 80's and 90's as result of intense industrial development during this period.

c) Both unit Domestic and Industrial flows will remain relatively constant after year 2000 as near ultimate development will have been attained.

C. **Industrial Flow:**

Greeley and Hansen Engineers, in their report entitled "Report on Basic Data", projected the following unit industrial flow for the MSDGC's northwest area in gallons per acre per day (GPAPD):

Industrial Flow (GPAPD)		
1960	1985	2015
3200	5500	6400

Brown and Caldwell, in their report for O'Hare WRP, modified Greeley and Hansen's estimate to the following:

Industrial Flow (GPAPD)		
1960	1985	2015
3200	5200	5200

Camp, Dresser & McKee, in their report for Egan WRP (formerly Salt Creek), serving Facility Area adjacent to O'Hare used a value of 6400 GPAPD for unit industrial discharge in 2020.

The MSDGC staff considered all of the above estimates and concluded that unit industrial wastewater loading of 3200 GPAPD was reasonable. It was also concluded that this value would remain constant due to such factors as increased recycling and more stringent regulations applying to industrial discharges.

Based on NIPC Land Use information, the MSDGC staff estimated that industrial land use will increase from approximately 2000 ac. in 1970 to 7300 ac, by year 2000.

Industrial development and flow is projected as follows:

Year	Industrial Acres	Flow MGD @ 3200 GPAPD
1970	2000	6.4
1980	5000	16.0
1990	6500	20.8
2000	7300	23.4
2010	7300	23.4
2020	7300	23.4
2030	7300	23.4

D. Infiltration:

Maximum allowable infiltration in the O'Hare Combined Sewer Area equalled 2.93 MGD in 1974(1).

Maximum allowable infiltration in the O'Hare Separate Sewer Area equalled 5.08 MGD in 1974(1).

Estimated population in O'Hare Facility Area in 1974: Combined Area = 59,200, Separate Area = 186,000, and Total = 245,200.

Therefore, assuming 100% of population to be connected, allowable infiltration in 1974 in terms of GPCPD equalled:

Combined Area = (2.93/59.200)=49.5 GPCPD
Separate Sewer Area = (5.08/186,000)=27.4 GPCPD

It can be assumed that population in combined sewer area (older established part of the community) will remain relatively constant.

Therefore, increase in allowable infiltration will be approximately proportional to the increase of population in the separate sewered area.

Year	Pop. in Comb. Area x 1000	Flow (MGD) @ 49.5 GPCPD	Pop. in Sep. Area x 1000	Flow (MGD) @ 27.4 GPCPD
1970	59.2	2.93	155.6	4.34
1980	62.2	3.08	198.8	5.45
1990	63.7	3.15	213.3	5.84
2000	63.7	3.15	236.3	6.47
2010	63.7	3.15	251.3	6.89
2020	63.7	3.15	268.3	7.35
2030	63.7	3.15	286.3	7.84

Projected Allowable Infiltration in Terms of GPCPD

Year	Total All. Infil. Flow (MGD)	Pop. x 1000	GPCPD
1970	7.27	223	33
1980	8.53	261	33
1990	8.99	277	33
2000	9.62	300	32
2010	10.04	315	32
2020	10.50	332	32
2030	10.99	350	31

Footnote:

(1) MSDGC I/I Analysis for O'Hare Service Area.

III. Flow Projection

In the preceding sections, the following was established:

- a. Measured flow in 1970 = 150 GPCPD (Ave. Dry Weather Flow)
- b. Water Pumpage Record in 1970 = 113 GPCPD (Ave. for O'Hare S.A.)
- c. Unit Industrial Flow in 1970 = (6.4/223,000) = 29 GPCPD
- d. Allowable Infiltration in 1970 = 33 GPCPD

Although water pumpage record is a good indication of per capita consumption, it usually does not represent the actual amount reaching the sewer. Leakage within the water distribution system, water used for gardens and lawns, and other miscellaneous uses account for the disparity. For the O'Hare Facility Area, it is assumed that 10% of the recorded consumption does not enter the sewer.

Therefore, unit wastewater flow from Industrial and Domestic sources in 1970 was (113 - 10%(113))=102 GPCPD. Adding the allowable infiltrati flow of 33 GPCPD, the total unit wastewater flow in 1970 should have bee 102+33= 135 GPCPD. The difference between the measured, 150 GPCPD, and the calculated, 135 GPCPD, is attributed to excessive infiltration.

In summary, 1970 flow can be broken down to the following:

Source	GPCPD
Domestic	73
Industrial	29
Allowable Infiltration	33
Excessive Infiltration	15
TOTAL	150

Using 1970 as the base, the O'Hare Facility Area flow is projected as follows:

GALLONS PER CAPITA PER DAY

				Infiltration			
Year	Pop. (1000)	Domestic	Industrial	Allow.	Exc.	Total	Flow (MGD)
1970	223(1)	73	29	33	15	150	30
1980	261	80	61	33	0	174	45
1990	277	94	75	33	0	202	56
2000	300	113	78	32	0	223	67
2010	315	116	74	32	0	222	70
2020	332	117	70	32	0	219	73
2030	350	118	67	31	0	216	75

(1) Sewered Pop. in 1970 = 200,700

Design Flow = Calculated Flow x 1.1 (10% Reserve Capacity)

Year	Design Flow (MGD)
1970	33
1980	50
1990	62
2000	73
2010	77
2020	80
2030	83

IV. Economic Analysis

The following cost effective analysis for O'Hare WRP is performed in accordance with the EPA Guidelines (40 CFR Part 35) Amended portion of FWPC Act Amendments.

A. Elements of Analysis

1. Method of Analysis....................Present Worth
2. Planning Period.......................22 years (1978-2000)
3. Elements of Costs.....................Capital&M&O (Labor, Ener Chemicals)
4. Prices................................Indexed to ENR=2400 (Inflation not included)
5. Interest Rate.........................5 7/8%
6. Interest During Construction..........Ic=IxPxC/2

   I=5.875%
   P=Const. Period in Years
   C=Total Capital Cost
7. Salvage Values........................Straight Line Depreciati
8. Service Life

Land	Permanent
Structures	30-50 years
Process Equip.	15-30 years
Aux. Equip.	10-15 years

B. Plant Sizes for Phased Construction

The projected flow indicates that the initial installation should not be less than 60 MGD, since a smaller capacity plant would resu in a service life of 10 years or less. Therefore, phased construc will consist of 60 MGD initial installation in 1978 and 12 MGD addition in 1988.

C. Capital Costs

1. Cost of 72 MGD Plant:

Estimated by consultant for O'Hare WRP:

Cost: $100,000,000.00

2. Cost of 60 MGD Plant:

Based on cost curves developed by Robert Smith (1), the cost ratio of 72 MGD to 60 MGD is approximately 1.05 to 1.00. Therefore, cost of 60 MGD plant would be:

Cost = (1.00/1.05)($100,000,000.00) = $95,200,000.00

(1) Ref: Robert Smith "Cost of Conventional and Advanced Treatment of Wastewater", JWPCF Conference Issue, September 1968.

3. Cost of 12 MGD Addition:

It is assumed that the initial 60 MGD installation will provide space for additions of blowers, pumps, etc., and that 12 MGD addition can be easily facilitated.

Aeration Tanks		$2.22 Million
Diffused Air System		1.20
Final Settling Tanks		1.82
Pumps		0.86
Filters		1.80
Site Work		0.22
Instrumentation (Elec., Plumbing)		2.96
Miscellaneous		0.50
		11.58
Design, Legal, Administrative, Printing, Advertising etc. 15%		1.74
Contingency 15%		1.74
	TOTAL	$15.06 Million

D. Replacement Costs

1. 72 MGD Plant

$14.4 Million in 1993

$ 1.0 Million in 1998

2. 60 MGD Plant

$12.6 Million in 1993

$ 1[illegible] Million in 1998

E. Salvage Values

1. 72 MGD Plant..............................$47.6 Million in 2000

2. 60 MGD Plant + 12 MGD Addition............$48.4 Million in 2000

F. M&O Costs

1. 72 MGD Plant

	In. 1978	In. 2000
Personnel	817,000	1,057,000
Pumping	383,000	608,000
Air (Blowers)	552,000	876,000
Misc. Energy	50,000	80,000
Chemicals	110,000	175,000
	1,912,000/yr.	2,796,000/yr.

Equivalent Annual Cost = $2,244,000/yr.

2. 60 MGD Plant + 12 MGD Addition in 1988

	In 1978	In 2000
Personnel	710,200	1,057,000
Pumping	383,000	608,000
Air (Blowers)	458,000	876,000
Misc. Energy	50,000	80,000
Chemicals	110,000	175,000
	1,711,200/yr.	2,796,000/yr.

Equivalent Annual Cost = $2,097,000/yr.

G. Interest During Construction

1. 72 MGD Plant

$$\frac{100 \times 3 \times 0.05875}{2} = \$8.82 \text{ Million}$$

2. 60 MGD Plant + 12 MGD in 1988

$$60 \text{ MGD} = \frac{95.2 \times 3 \times 0.05875}{2} = \$8.39 \text{ Million}$$

$$12 \text{ MGD} = \frac{15.1 \times 1.5 \times 0.05875}{2} = \$0.67 \text{ Million}$$

H. Present Worth Comparison

1. 72 MGD Plant

Item	Cost ($ Million)
Initial Construction	100.00
Replacement (14.4)(0.425)	6.12
Replacement (1.0)(0.319)	0.32
Salvage (47.6)(0.284)	-13.52
M&O (1.853)(12.17)x 10^6	27.32
Int. During Const.	8.82
Total	$129.06 Million

2. 60 MGD in 1978 + 12 MGD in 1988

Item	Cost ($ Million)
Initial Construction 60 MGD	95.20
12 MGD Addition (15.06)(0.565)	8.51
Replacement (12.6)(0.425)	5.36
Replacement (1.0)(0.319)	0.32
Salvage (48.4)(0.284)	-13.75
M&O (1.743)(12.17)x 10^6	25.53
Int. During Const. - Initial Plant	8.39
Int. During Const - Addition	0.38
Cost of Redesign	0.30
	$130.24 Million

Based upon the foregoing analysis, it is more cost effective to construct a 72 MGD plant under one contract than it is to phase the construction into two contracts.

APPENDIX Q

ADDITIONAL SITE INFORMATION SUBMITTED BY MSDGC

ATTACHMENT A

Part I - Pertinent Technical Information for Each Site

Pertinent technical information for each site has been assembled and is presented herein. Each site is identified in either the Draft EIS prepared by the Region V USEPA for the O'Hare WRP and Solids Pipeline, or the EAS prepared by the MSDGC for the Upper Des Plaines Service Basin. See Figure 1 for location of sites studied.

Each site is analyzed in terms of thirteen (13) specific factors and one (1) general consideration. Explanation and applicability of these factors used in assessing the various sites are given below:

A. Location:

Self explanatory.

B. Area in Acres:

Area of each site, unless specifically known, is based on approximate land area as determined through field surveys and recent aerial photographs. Boundaries were established where they appeared to be reasonable.

C. Physical Description:

1) Geological:

Geological description for soil, surficial and bedrock strata are not presented for each site. However, in view of the fact that every site considered is within close proximity of site No. 1, (within 3 mile radius) the generalized geological description given in the EAS for that site is assumed to apply for all other sites. For a detailed geological description, reference is made to MSDGC's EAS for The Upper Des Plaines Service Basin Nov. 1974, pgs. II-3 to II-11 of O'Hare Tunnel System, and pgs. II-2 to II-4 of O'Hare WRP.

2) Topographical:

Description of topography of each site is given in terms of estimated maximum variation in ground elevation. Sites which contain flood plain land are designated as such.

D. Improvements on Site:

Any existing structures above or below ground are considered to be improvements on the site. Therefore, utility pipelines, water storage tanks, single family houses, barns, offices, garages, manufacturing buildings, parking lots and driveways are all considered to be improvements existing on site. The owner(s) of these improvements must be equitably compensated for his (their) losses.

E. Site Zoning and Description of Surrounding Area:

Zoning of the specific site is taken from Olcott's Land Values as are the zoning of areas adjacent to the site of interest. Description of the surrounding area is based on field surveys and recent aerial photographs.

F. Availability of Land:

As a baseline assumption it is assumed that all sites can be purchased outright or acquired through condemnation proceedings. However, time required to obtain the various sites depends on such factors as who the owner is, how many owners there are, what improvements exist on the site, and whether condemnation process can be enforced. Procurement time also includes site study, appraisals, title search, negotiation, and MSD Board action.

G. Receiving Stream:

Name of stream is given in which plant effluent would be discharged. "On-Site" indicates that the stream flows through or adjacent to the site.

H. Length of Outfall Conduit:

Self explanatory.

I. Channel Improvements Required on Plant Site and Downstream of Plant Site:

On sites which require channel improvements, the hydraulic capacity of the receiving stream is increased to handle the 100 year design storm flow. The different storm flow values at the sites reflect the variations in tributary drainage area.

Channel improvements downstream of the plant site are based on hydraulically accommodating the maximum plant flow plus the 100 year design storm.

Channel is improved to a point where the stream is capable of handling this flow without utilizing overbank capacity.

J. Channel Relocation Required on Plant Site:

Depending on the site and whether the stream flows through the site, the stream or the channel must be relocated in order to provide space for the treatment plant. Length of channel requiring relocation is given.

K. Length of Influent Sewer:

The 20 ft diameter tunnel has its low point near the intersection of Oakton and Elmhurst Rd. From here wastewater must be conveyed to the plant pump station via 10 ft diameter plant influent sewer. Length of this sewer varies depending on the location of the site.

L. Compensatory Storage:

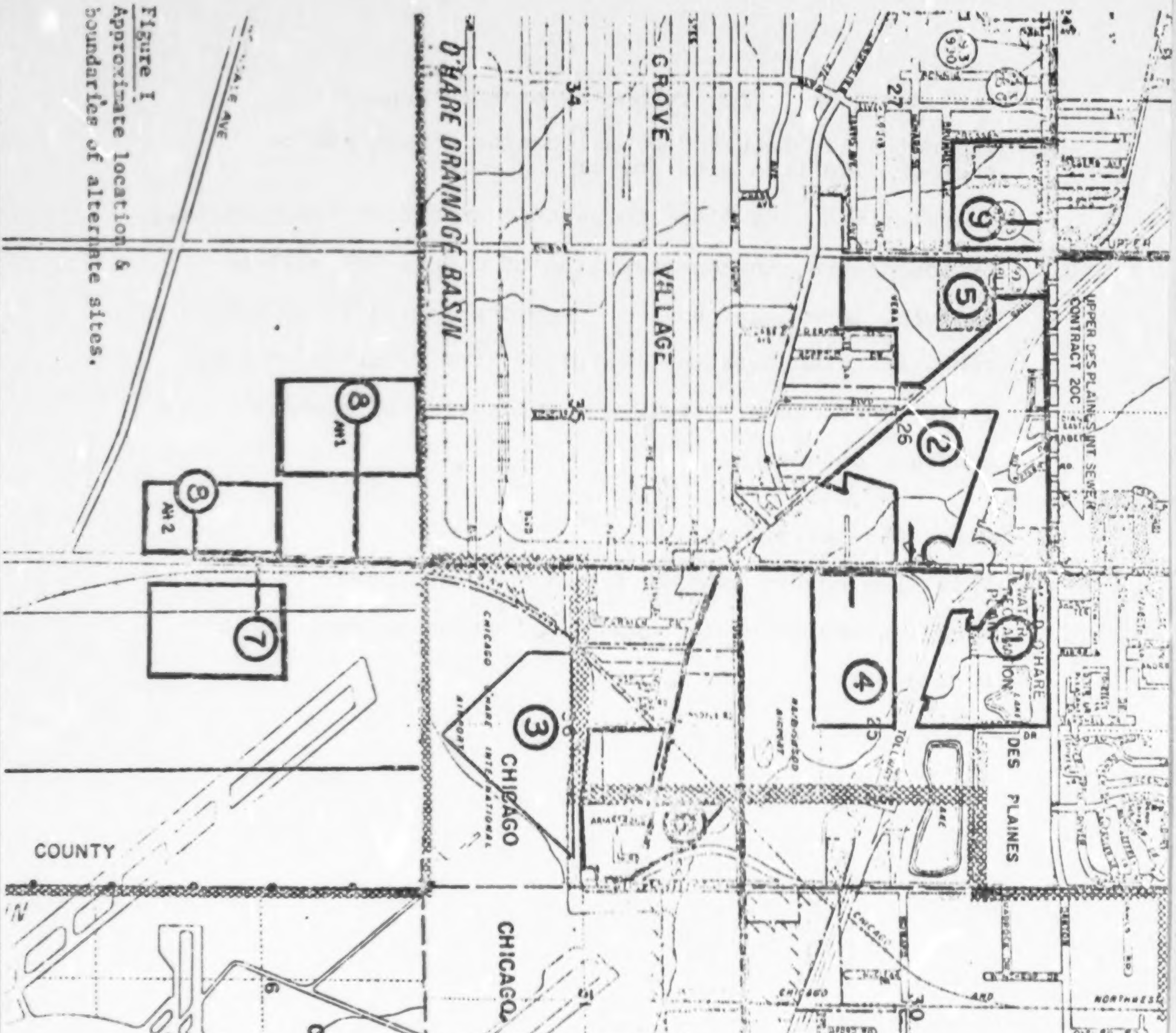
Plant sites which include flood plain area must provide compensatory storage facility. The required compensatory storage in AC-FT is based on volume of flood plain displaced at the site due to construction of the plant. Volumes given include 10 ac-ft for retention of site runoff.

M. Project Delay Incurred by Relocating O'Hare WRP to Another Site from Site No. 1:

In relocating the plant to another site from the presently proposed site, the construction of O'Hare WRP will be delayed. The delay will be caused principally by time required to acquire the land, and time required to relocate business or people and to design and prepare contract documents.

N. Other Considerations:

This item covers special features which appear to be of some significance in considering the particular site for the O'Hare WRP.



ELK GROVE VILLAGE
O'HARE DRAINAGE BASIN
UPPER DES PLAINES INT SEWER CONTRACT 20C
DES PLAINES
COUNTY
CHICAGO
CITY OF CHICAGO
CHICAGO O'HARE INTERNATIONAL AIRPORT
CHICAGO AND NORTHWESTERN
O'HARE LAKE
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Figure I
Approximate location &
boundaries of alternate sites.

Site No. 1

1)	Location	Des Plaines - East of Elmhurst Rd. South of Oakton Rd., North of NW Tollway
2)	Area (Acres)	104
3)	Physical Description	Geological: (See introductory text) Topo Est. Variation from 654 to 660 MSL Approx. Half of Site in Flood Plain
4)	Improvements on Site	One Single Family Dwelling Owned by MSDGC. Purchased by MSDGC on 10/26/72 for $42,500.
5)	Site Zoning and Description of Surrounding Area	Site Zoned for Restricted and General Industry N: Gas Station, Florist, and 20 Houses (North Zoned for Residential) E: Gas Station, Motel, Industry W: Industry S: One House, Trailer Park (East, West, South Zoning same as Site)
6)	Availability of Land	Owned by MSDGC (Purchased in 1966 for $1,651,800)
7)	Receiving Stream	Higgins Creek - On Site
8)	Length of Outfall (FT)	200
9)	Channel Improvements Required on Plant Site and Downstream of Plant Site (CFS)	516
10)	Channel Relocation Required on Plant Site (FT)	1500
11)	Length of Influent Sewer From Tunnel to Plant (FT)	700
12)	Compensatory Storage Required (AC-FT)	60
13)	Project Delay Incurred by Relocating O'Hare WRP to Site No. 1	NONE
14)	Other Considerations	MSDGC's Selected Site for O'Hare WRP

Site No. 2

1)	Location	Unincorporated Area of Cook County South of NW Tollway, West of Elmhurst Rd., North of Higgins Rd.
2)	Area (Acres)	94
3)	Physical Description	Geological: (See introductory text) Topo: Est. Variation from 658 to 664 MSL Most of Site in Flood Plain
4)	Improvements on Site	No Above Ground Structures. Dubuque Gas Co; Gas Pipelines 22", 30" amd 36" Shell Oil Co; Oil Pipeline 14" Illinois Bell; Talephone Cables West Shore Pipeline Co; Gas Pipeline 16" Badger Pipeline Co; 6" and 8"
5)	Site Zoning and Description of Surrounding Area	Site Zoned for Restricted and General Industry NE: Commerce and light industry. E: Trailer Park, commerce and industry. SW: Mixture of residential, commerce and industry. Site entirely surrounded by Restricted & General Ind. Zoning
6)	Availability of Land	Owned by MSDGC (purchased in 1974 for $4,229,807)
7)	Receiving Stream	Higgins Creek - On Site
8)	Length of Outfall (FT)	200
9)	Channel Improvements Required on Plant Site and Downstream of Plant Site (CFS)	318
10)	Channel Relocation Required on Plant Site (FT)	1500
11)	Length of Influent Sewer From Tunnel to Plant (FT)	1000
12)	Compensatory Storage Required (AC-FT)	54
13)	Project Delay Incurred by Relocating O'Hare WRP to Site No. 2	Concurrent Activities: Utility Relocation & Design, Reviews, Etc. 36 mos. TOTAL= 36 mos.
14)	Other Considerations	This site was purchased by MSDGC for use as a reservoir in the O'Hare TARP System.

Site No. 3

1)	Location	O'Hare Int. Airport Maintenance Expansion Area
2)	Area (Acres)	Approx. 65
3)	Physical Description	Geological: (See introductory text) Topo: Est. Variation 657 to 664 MSL
4)	Improvements on Site	No above or below grade improvements as far as is known.
5)	Site Zoning and Description of Surrounding Area	This site is part of O'Hare Airport and borders private land to the north only. The adjacent area is zoned for residential and industrial uses.
6)	Availability of Land	Availability not known-Airport authority possibly reserving land for specific future use-Acquisition by condemnation possible, but likely to require up to two (2) years of proceedings.
7)	Receiving Stream	Willow Creek - On Site
8)	Length of Outfall (FT)	300
9)	Channel Improvements Required on Plant Site and Downstream of Plant Site (CFS)	(None Required)
10)	Channel Relocation Required on Plant Site (FT)	(None Required)
11)	Length of Influent Sewer From Tunnel to Plant (FT)	9000
12)	Compensatory Storage Required (AC-FT)	10
13)	Project Delay Incurred by Relocating O'Hare WRP to Site No. 3	Land Acquisition 24 mos. Design, Reviews, Etc. 36 TOTAL=60 mos.
14)	Other Considerations	

Site No. 4

1) Location	Unincorporated Area of Cook County East of Elmhurst, South of NW Tollway
2) Area (Acres)	Approx. 80
3) Physical Description	Geological: (see introductory text) Topo: Est. Variation 650 to 660 MSL
4) Improvement on Site	Facilities for approx. 600 mobile homes plus additional 125 presently being relocated from Busse Woods.
5) Site Zoning and Description of Surrounding Area	Site Zoned for Restricted and General Industry N: Site No. 1 across NW Tollway E: Empty parcel of land including old Ravenswood Airpo W: Industry and Commerce (Site No. 2) SW: Standard Oil Fuel Storage Tanks Site totally surrounded by Restricted and Ind. Zoning
6) Availability of Land	Availability Unknown-At least three owners involved in negotiations-Condemnation possible-Proceedings likely to take up to 1.5 years
7) Receiving Stream	Higgins Creek - On Site
8) Length of Outfall (FT)	300
9) Channel Improvements Required on Plant Site and Downstream of Plant Site (CFS)	539
10) Channel Relocation Required on Plant Site (FT)	(None Required)
11) Length of Influent Sewer From Tunnel to Plant (FT)	2000
12) Compensatory Storage Required (AC-FI)	11
13) Project Delay Incurred by Relocating O'Hare WRP to Site No. 4	Land Acquisition 18 mos. Concurrent Activities: Relocation of People and Design, Reviews, Etc. 36 Total 54 mos.
14) Other Considerations	Federal Relocation Act applies-Approx. 2400 people residing in mobile homes would have to be relocated-Relocation to another mobile home community would have to be outside Cook County because of the present County ban on construction of new mobile home sites.

Site No. 5

1)	Location	Unincorporated Area of Cook County East of Busse, South of Higgins Rd.
2)	Area (Acres)	Approx. 85
3)	Physical Description	Geological: (See introductory text) Topo: Est. Variation from 670 to 680 MSL
4)	Improvements on Site	SDK Industrial Park under Construction-Building dimensions 740' x 690' x 22'-Est. Const. Cost $30.0 Million-Indust. Park occupies approx. 25 Acres
5)	Site Zoning and Description of Surrounding Area	Site Zoned for Restricted and General Industry NE: Commerce and Industry SE: Residential and Industry S: Industry W: Industry A portion of area to south zoned for residential uses. All other area zoned for Restricted and General Industry.
6)	Availability of Land	Availability Unknown-All or portions of SDK Industrial Park may be necessary-Acquisition by Condemnation possible-Negotiations and/or legal proceedings likely to take 1.0 year.
7)	Receiving Stream	Higgins Creek - On Site
8)	Length of Outfall (FT)	200
9)	Channel Improvements Required on Plant Site and Downstream of Plant Site (CFS)	300
10)	Channel Relocation Required on Plant Site (FT)	500
11)	Length of Influent Sewer From Tunnel to Plant (FT)	5000
12)	Compensatory Storage Required (AC FT)	16
13)	Project Delay Incurred by Relocating O'Hare WRP to Site No. 5	Land Acquisition 12 mos. Concurrent Activities: Relocation of Business Design, Reviews, Etc. 36 Total 48 mos.
14)	Other Considerations	

Site No. 6

1)	Location	Unincorporated Area of Cook County West of Mount Prospect Ave., South of Touhy
2)	Area (Acres)	Approx. 100
3)	Physical Description	Geological: (See introductory test) Topo: Est. Variation 651 to656 MSL
4)	Improvements on Site	Approximately 10 industrial firms and 20 residential houses are located on this site.
5)	Site Zoning and Description of Surrounding Area	Site is Zoned for Single Dwelling Residential, Restricted and General Industry. N: Mostly unoccupied land E: Approach area for runway W: Residential and industry. S: O'Hare Airport Maintenance Expansion Area. Area to E, N and W are zoned for restricted and general Industry.
6)	Availability of Land	Availability Unknown-Negotiations for land acquisition would involve 20 to 30 owners-Condemnation possible-Legal proceedings likely to take up to 1.5 years.
7)	Receiving Stream	Higgins Creek - On Site
8)	Length of Outfall (FT)	200
9)	Channel Improvements Required on Plant Site and Downstream of Plant Site (CFS)	(None Required)
10)	Channel Relocation Required on Plant Site (FT)	(None Required)
11)	Length of Influent Sewer Fron Tunnel to Plant (FT)	7300
12)	Compensatory Storage Required (AC-FT)	10
13)	Project Delay Incurred by Relocating O'Hare WRP to Site No. 6	Land Acquisition 18 mos. Concurrent Activities: Relocation of Business & People Design, Reviews, Etc. 36 Total 54 mos.
14)	Other Considerations	Site is divided by Old Higgins Road. Federal Relocation Act applies - all businesses and private citizens must be compensated in accordance with the Act.

Site No. 7

1)	Location	DuPage County Part of O'Hare Intl. Airport approach area for Runway 9L
2)	Area (Acres)	Approx. 100+.
3)	Physical Description	Geological: (See introductory text) Topo: Est. Variation 659 to 662 MSL Most of site in flood plain-The site is very wet and marshy
4)	Improvements on Site	No above or underground improvements known to be existing on site.
5)	Site Zoning and Description of Surrounding Area	The site is surrounded by O'Hare Airport to the north, east and south. The area to west, across Elmhurst Rd., is zoned for restricted and general industrial uses.
6)	Availability of Land	Availability Unknown-Land Acquisition by condemnation not possible-Negotiations likely to take over 2.0 years
7)	Receiving Stream	Willow Creek
8)	Length of Outfall (FT)	200
9)	Channel Improvements Required on Plant Site and Downstream of Plant Site (CFS)	(None Required)
10)	Channel Relocation Required on Plant Site (FT)	(None Required)
11)	Length of Influent Sewer From Tunnel to Plant (FT)	13,000
12)	Compensatory Storage	10
13)	Project Delay Incurred by Relocating O'Hare WRP to Site No. 7	Land Acquisition 24 mos. Design, Reviews, Etc. 36 TOTAL= 60 mos.
14)	Other Considerations	MSDGC has no power of condemnation in DuPage County-The site appears to be in or near "Clear Zone", where above ground structures are prohibited-No direct access to site unless overpass or underpass is built across C&NW R.R.-Wet condition of site may require pilings for all structures.

Site No. 8A

1)	Location	Unincorporated Area of DuPage County South of Devon, West of Elmhurst
2)	Area (Acres)	Approx. 75
3)	Physical Description	Geological: (See introductory text) Topo: Est. Variation 656 to 665 MSL Half of site in flood plain
4)	Improvements on Site	Approx. 8 industrial firms located on eastern side of property-4 residential houses on western side.
5)	Site Zoning and Description of Surrounding Area	Site Zoned For Industry- N&E: Southern and western edge of Centex Industrial Park W: Approx. 12 residential houses S: Unoccupied land within corporate limits of Bensenville Surrounding area to North, West and South are zoned for Light Industry.
6)	Availability of Land	Availability Unknown-Land Acquisition by condemnation not possible-Direct negotiations with owners likely to take 2.0 years.
7)	Receiving Stream	Branch of Willow Creek - On Site
8)	Length of Outfall (FT)	200
9)	Channel Improvements Required on Plant Site and Downstream of Plant Site (CFS)	585
10)	Channel Relocation Required on Plant Site (FT)	2000
11)	Length of Influent Sewer From Tunnel to Plant (FT)	12,400
12)	Compensatory Storage Required (AC-FT)	32
13)	Project Delay Incurred by Relocating O'Hare WRP to Site No. 8A	Land Acquisition 24 mos. Design, Reviews, Etc. 36 TOTAL= 60 mos.
14)	Other Considerations	MSDGC does not have power of eminent domain in DuPage County.

Site No. 8B

1)	Location	Unincorporated Area of Du Page County West of Elmhurst, North of Flick-Reedy
2)	Area (Acres)	Approx. 75
3)	Physical Description	Geological: (See introductory text) Topo: Est. Variation 656 to 666 MSL Half of site in flood plain
4)	Improvements on Site	No improvements on site as far as is known.
5)	Site Zoning and Description of Surrounding Area	Site Zoned for Industry N: Southern edge of Centex Ind. Park W: Unoccupied land within corporate limits of Bensenville S: Industry (Flick-Reedy) E: O'Hare Airport Site totally surrounded by industry zoning
6)	Availability of Land	Land known to be for sale, but if mutually agreeable price cannot be reached between owners and MSD, condemnation process cannot be used to acquire this site. Negotiations likely to take at least 2.0 years.
7)	Receiving Stream	Branch of Willow Creek - On Site
8)	Length of Outfall (FT)	200
9)	Channel Improvements Required on Plant Site and Downstream of Plant Site (CFS)	585
10)	Channel Relocation Required on Plant Site (FT)	(None Required)
11)	Length of Influent Sewer From Tunnel to Plant (FT)	12,400
12)	Compensatory Storage Required (AC-FT)	32
13)	Project Delay Incurred by Relocating O'Hare WRP at Site No. 8B	Land Acquisition 24 mos. Design, Reviews, Etc. 36 TOTAL= 60 mos.
14)	Other Considerations	MSDGC does not have power of eminent domain in Du Page County.

Site No. 9

1)	Location	Unincorporated Area of Cook County South of Oakton, West of Busse, East of Crossen, North of Brummel
2)	Area (Acres)	Approx. 80
3)	Physical Description	Geological: (See introductory text) Topo: Est. Variation 683 to 686 MSL
4)	Improvement on Site	3 houses, 1 farm structure, 10 light industrial [illegible] manufacturing firm (Halo Lighting-Bldg. Dimension 900' x 990' x 26')
5)	Site Zoning and Description of Surrounding Area	Size Zoned for Restricted and General Industry N: Industry and unoccupied land. E: Industry and commerce S&W: Approx. 20 light industrial firms Site totally surrounded by Restricted and General Industry zoning
6)	Availability of Land	Availability unknown-A portion of Halo Lighting would be required-Acquisition by condemnation possible-Legal proceedings likely to take 2.0 years
7)	Receiving Stream	No receiving stream on site
8)	Length of Outfall (FT)	2700
9)	Channel Improvements Required on Plant Site and Downstream of Plant Site (CFS)	185
10)	Channel Relocation Required on Plant Site (FT)	None Required
11)	Length of Influent Sewer From Tunnel to Plant (FT)	7290
12)	Compensatory Storage Required (AC-FT)	None Required
13)	Project Delay Incurred by Relocating O'Hare WRP to Site No. 9	Land Acquisition 24 mos. Concurrent Activities: Relocation of People & Business Design, Reviews, Etc. 36 Total 60 mos.
14)	Other Considerations	

Site No. 10

1)	Location	Unincorporated Area of Cook County South of N.W. Tollway, West of Wolf Rd.
2)	Area (Acres)	100+
3)	Physical Description Geological:	(See Introductory text) Topo: Est. variation from 645 to 655 MSL. Most of site in Flood Plain.
4)	Improvements on Site:	No above or below grade improvements as far as is known.
5)	Site Zoning and Description of Surrounding Area:	Site mostly zoned for single family houses. N: Residential zoning across N.W. Tollway E: Unoccupied land zoned for Residential S: O'Hare Intl. Airport W: Restricted and General Industry
6)	Availability of Land	Availability not known - condemnation possible - outright purchase more likely - negotiation for acquisition probably within 1.0 year
7)	Receiving Stream	Willow Creek - On Site
8)	Length of Outfall (ft)	200
9)	Channel Improvements Required on Plant Site & Downstream of etc. (CFS)	653
10)	Channel Relocation Required on Plant Site (FT)	900
11)	Length of Influent Sewer From Tunnel to Plant (FT)	10,500
12)	Compensatory Storage Required (AC-FT)	217
13)	Project Delay Incurred By Relocating O'Hare WRP to Site No. 10	Land Acquisition 12 mos. Design Reviews Etc. 36 mos. Total 48 mos.
14)	Other Consideration	

Part II - Cost Effective Analysis

Cost effective analysis was performed on the ten (10) possible plant sites identified in Part I.

The ten sites are costed based on monies required to render the site usable for a sewage treatment plant, and the additional monies required in relocating the O'Hare WRP to another site from the present plant location, Site No. 1.

The cost analysis is summarized in Tables I and II. Table I indicates two totals, one without consideration to time value of money and one with. The former assumes that the cost of construction will remain unchanged, whereas the latter assumes that cost of constructing the plant will increase at a rate approximately equal to 1.0% per month above the currently estimated construction cost of O'Hare WRP ($100 million). The first total, without consideration to time value of money, (which, we believe, is an unrealistic assumption) demonstrates that even with zero cost escalation, keeping the O'Hare WRP at the presently proposed site is the most cost effective alternative. The second total, with consideration given to time value of money, represents the more realistic value of additional costs which would be incurred in relocating the plant to another site.

Table II summarizes the cost effective analysis based on energy consumption at various sites. The amounts given are the present worth of the estimated annual power cost at each site from 1978 to 2000.

Explanation of cost elements and their criteria are as given below:

A. Land Costs:

Land costs are derived using Olcott's Land Value Blue Book of Chicago, 1974. Sites No. 1 and No. 2 result in no additional cost to the MSDGC as they are presently owned by the MSDGC. Values for Sites 3 through 10 represent the difference between selling price of Site No. 1 and purchase price of an alternate site. Minus indicates that land cost for that particular site was less than the selling price of Site No. 1 resulting in a net gain. Thus, the amount is subtracted from the total.

B. Influent Sewer:

The influent sewer costs for various sites are derived by using the following criteria:

1) Diameter = 10 ft

2) Slope = 0.001

3) Cost Per Foot = $600

4) Invert Elev. of 20 Ft. Main Tunnel Adjacent to Site No. 1 = -80.02 CCD

5) Invert Elev. of 10 Ft. Influent Sewer Adjacent to Site No. 1 = -95.00 CCD

C. Outfall Conduit, Improvements to Channel on Plant Site, Improvements to Channel Downstream of Plant Site, Relocation of Channel and Compensating Reservoir:

Criteria used for costing these items are as follows:

1) Hydrologic Data:

Site	Bank Fill Capacity (CFS)	Bank* Elev.	Design Storm Flow (CFS)	Design Storm Elev.
1	306	654.1	822	656.1*
2	112	657.5	430	658.3
3	NA	657.6	1055	650.8
4	370	651.2	909	653.7*
5	NA	NA	NA	NA
6	NA	651.5	1137	647.5
7	NA	659.7	895	652.8
8A	182	656.8	767	658.3
8B	182	656.8	767	658.3
9	NA	NA	NA	NA
10	1397	645.6	2050	646.4

Notes:

a) NA - Information Not Available

b) On Site Detention - 10 Acre Ft. (All Sites)

c) Average Daily Plant Flow - 72 MGD.

d) Maximum Plant Flow - 120 MGD.

e) Plant Outfall Conduit Capacity - 192 MGD.

f) * Includes Maximum Plant Flow

2) Cost Data:

a) Compensatory Storage - $8,000/Acre Ft.

b) Channel Improvement on Plant Site at Design Storm Flow - - - - - - - $3/cu. yd.

c) Channel Improvement Downstream of Plant Site at Design Storm Flow Plus Maximum Plant Flow - - - - - - - $3/cu. yd.

d) Channel Relocation at Design Storm Flows - - - - - - - - - - - $3/cu. yd.

e) Plant Outfall Conduit, 7 ft. Diameter - - $350/ft.

D. Reimbursements to Displaced Businesses and People: Cost for this element is based on an estimated value of businesses and personal properties affected at each site. All of the applicable requirements set forth in the Federal Relocation Act are assumed to be enforced in deriving this cost.

E. Additional Design Cost:

This cost element applies to every site except for Site No. 1, where the treatment facility has already been designed.

It is believed that a plant at each site must be tailor-designed to suit that specific site. Critics have argued that O'Hare WRP as designed for Site No. 1 could be "transplanted" to another site necessitating only slight modifications in the design. While this argument may be partly true, there are factors such as ground conditions, location and elevation of receiving stream, arrangement of main buildings, and arrangement of processes in relation to the buildings which make the translation of the Site No. 1 plant in its present configuration most difficult, if not impossible. With the possible exception of Site No. 4, relocating O'Hare WRP to any other site would require a complete redesign.

F. Anticipated Increase in Construction Cost Due to Delays:

This cost element merely represents a trend of spiralling construction cost which is associated with time.

TABLE I - Cost Comparison of Relocating [illegible] to Another Site from Site No. 1.
(Cost = X $1,000)

COST FACTORS	SITE NO. 1	SITE NO. 2	SITE NO. 3	SITE NO. 4
Land	0 (104 Ac @ $1.06 sqft Est. Value = $4.8M)	0 (94 Ac Purchased for $4,220,800 in 1974)	+1,700 (85 Ac @ $1.75sqft Est. Value = $6.5M)	-2,000 (80Ac @ $0.80sqf Est. Value = $2.8
Influent Sewer	420	600	5,400	1,200
Outfall Conduit	70	70	105	105
Imprv. to Channel Downstream of Plant	0	0	0	30
Imprv. to Channel Plant Site	90	30	0	0
Relocation of Channel on Plant Site	70	36	0	0
Compensating Reservoir	480	432	80	88
Reimb. to Businesses & People for Assets & Relocation Expense	0	1,183	0	4,360
Addt'l Design Cost	0	3,000	3,000	1,000
tal Without Time value of Money	1,130	5,301	10,285	4,783
nticipated Increase In onst. Cost Due to Delays	0	36,000	60,000	54,000
Total With Time Value of Money	1,130	41,301	70,285	58,783

(Cost = X $1,000)

COST FACTORS	SITE NO. 5	SITE NO. 6	SITE NO. 7	SITE NO. 8A
1) Land	-2,020 (85 Ac @ $0.75sqft Est. Value = $2.78M)	+650 (100 Ac @ $1.25sqft Est. Value = $5.45M)	+2,820 (100 Ac @ $1.75sqft Est. Value = $7.62M)	-1,200 (75 Ac @ $1.10sqf Est. Value= $3.6M
2) Influent Sewer	3,000	4,380	7,800	7,440
3) Outfall Conduit	70	70	70	70
4) Imprv. to Channel Downstream of Plant	32	0	0	22
5) Imprv. to Channel on Plant Site	42	0	0	75
) Relocation of Channel on Plant Site	12	0	0	85
) Compensating Reservoir	128	80	80	80
8) Reimb. to Businesses & People for Assets & Relocation Expense	3,780 *	8,165	0	5,186
) Addt'l Design Cost,	3,000	3,000	3,000	3,000
0) Total Without Time Value of Money	8,044	16,345	13,770	14,738
1) Antcptd Incr in Const. Cost Due to Delays	48,000	54,000	60,000	60,000
2) Total With Time Value of Money	56,044	70,345	73,770	74,738

* Reimbursement for SDK Industrial Park is included as it represents a potential cost. Depending on how the plant is arranged on this site, relocation expense can be reduced or eliminated entirely. For the latter cost would become $4.264M and $52.264 for with and without time value of money.

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TABLE I (Continued) - Cost Comparison of Relocating O'Hare WRP to Another Site from Site No. 1.
(Cost = X $1,000)

	COST FACTORS	SITE NO. 8B	SITE NO. 9	SITE NO. 10
1)	Land	-1,200 (75 Ac @ $1.10 sqft Est. Value = $3.6M)	-1,400 (80 Ac @ $1.00 sqft Est. Value = $3.4M)	+2,820 (100 Ac @ $1.15 sqft Est. Value = $7.62M)
2)	Influent Sewer	7,860	4,380	6,300
3)	Outfall Conduit	70	945	70
4)	Imprv. to Channel Downstream of Plant	0	62	0
5)	Imprv. to Channel on Plant Site	59	0	65
6)	Relocation of Channel on Plant Site	0	0	103
7)	Compensating Reservoir	256	80	1,726
8)	Reimb. to Businesses & People for Assets & Relocation Expense	0	6,500*	0
9)	Addt'l Design Cost	3,000	3,000	3,000
10)	Total Without Time Value of Money	10,045	13,567	14,084
11)	Anticipated Incr in Const Cost Due to Delays	60,000	60,000	48,000
12)	Total With Time Value of Money	70,045	73,567	62,084

*Reimbursement for Halo Lighting is included as it represents a potential cost. Depending on how the plant is arranged, relocation expenses can be reduced or eliminated. For the latter case, cost would become $7.067 and $67.067 for with and without time value of money.

TABLE II

Comparative Energy Costs at Various Sites

Site No.	Present Worth of Total Energy[1] Costs 1978-2000 ($)	Additional Energy Costs Incurred at Sites Other Than No. 1 Between 1978-2000 ($)
1	18,074,000	--
2	18,255,000	181,000
3	19,012,000	938,000
4	18,179,000	105,000
5	19,201,000	1,127,000
6	18,569,000	495,000
7	18,407,000	333,000
8A	19,141,000	1,067,000
8B	19,167,000	1,093,000
9	19,288,000	1,214,000
10	18,123,000	49,000

Notes:

1) Present Worth of Annualized Energy Cost includes energy required for air blowers, raw sewage pumping, and miscellaneous plant operations.

2) Energy requirement is assumed to increase linearly from 1978 to 2000.

3) Costs given are in 1975 dollars.

4) Interest rate assumed at 6.0%.

5) Unit energy cost assumed at $0.025/kw.hr.

ATTACHMENT B

The following comments are directed to the compatibility of existing land use surrounding each of the nine (9) alternate potential sites for the O'Hare WRP. These sites are identified in the USEPA Environmental Impact Statement for the plant. One additional site identified in the EAS prepared by MSDGC is commented on at the end of the list. (Identified as Site 10 in Attachment A)

These statements are prefaced by the following:

1. Since aesthetic aspects of plant design would, unquestionably, vary according to the site, they have a direct bearing on land use compatibility. With appropriate consideration given to architectural features, site and landscape design, each of the sites may be considered compatible with the land uses found around them.
2. Existing use on the potential sites is an extremely important factor in terms of relocation costs, inconvenience, construction delay and increased constructio cost. To the extent that these factors may be minimized, one particular site, site number one (1), is considered more compatible than the others.

Site #1 North of Northwest Tollway and East of Elmhurst Road

This 104 acre vacant site is bounded by industry on the east and west, the Northwest Tollway on the south and residential land on th north. The residential land is predominantly single family, detached units on lots about one half acre in size. The high quality proposed architectural design and site detailing, make this site compatible with the existing industrial, transportation and low densit surrounding land uses.

Site #2 - South of Northwest Tollway, West of Elmhurst Road
Northeast of Higgins Road

The Northwest Tollway separates this triangular site from an area of light industry on the north. To the east, separated by Elmhurst Road, is a tank farm and a large trailer park. Adjacent, on the south, is a developing area of light industry. To the south, across Higgins Road is an area of light industry and single family houses. The site is vacant. With some degree of architectural anc site detailing, this site would be compatible with the existing land uses in the area.

Site #3 - O'Hare Maintenance Expansion Area

This site, located on O'Hare International Airport, is the site of a potential stormwater reservoir. The surrounding land use is predominantly industrial in nature. Only routine architectural and siting considerations would be required for compatibility.

Site #4 - East of Elmhurst Road, South of Northwest Tollway
Unincorporated Cook County

A mobile home community is located on this site. Considerable relocation costs and delays would be encountered with development of this site since numerous families would be involved.

The vacant area north of the site is separated from it by the Northwest Tollway. To the east, a tollway plaza and an industrial area lie at the far side of a 90 acre tract of vacant land. To the south, industrial uses, separated by Higgins Road and a small vacant tract of land, represent the predominant land use. Industrial uses, across Elmhurst Road border the site to the west. Only routine architectural and site considerations would be required for compatibility with the existing land use.

Site #5 - East of Busse, South of Oakton

This site is in the Centex Industrial Park. Site #2 lies due east of it across Higgins Road. Industrial construction is taking place on the site and would cause considerable relocation difficulties and cost increases. Single family homes are located southeast of the site and compatibility with existing land use is slightly more dependent on a higher degree of archtectural design and site considerations because of this.

Site #6 - West of Mount Prospect Road, South of Touhy

This site has a few homes and several industrial developments. Old Higgins Road bisects the proposed site. Extensive relocation of businesses and residences would be necessary. Only routine site and architectural considerations are necessary for compatibility with existing uses.

Site #7 - Approach area Runway 9L

This site is located on O'Hare Airport. Development of this site may cause a safety hazard due to Runway 9L. Development of a WRP, therefore, would be inconsistent with airport operations.

Site #8 - Vacant parcels south of Devon, west of Elmhurst Road

These sites are located east and south of the Centex Industrial Park in DuPage County. Vacant land and industrial development surround these sites. Depending on the type of development of the adjacent area (most probably industrial), architectural and site considerations would range from standard to high quality to be compatible.

Site #9 - West of Busse, south of Oakton
Unincorporated Cook County

This site is part of the Centex Industrial Park. Site #5 lies due east of this site, across Busse Road. Only routine architectural and site considerations are necessary for compatibility with existing uses.

Site # 10-adjacent to O'Hare Airport, west of Lee Street

The site is bordered on the north by the Northwest Tollway. Residential and commercial areas are located north of the Tollway. The remaining three sides of the site are bordered by industrial development to the west and unoccupied land to the east and south. Only routine architectural and site considerations would be necessary for compatibility with existing uses.

ATTACHMENT C

Environmental Matrix:

A summary environmental matrix for the ten sites identified in either the EIS or the EAS is presented herein. The table is preceded by a brief discussion of environmental factors addressed for each site and justifications for assigning the indicated scores.

Environmental Factors:

A. Water Quality:

As a result of constructing the O'Hare WRP, the impact on the water quality will ultimately be beneficial and will affect the entire drainage basin. The quality of the receiving stream will be enhanced due to the anticipated high quality of O'Hare WRP's effluent. Other streams within the O'Hare Facility Area which presently receive combined sewer overflows will also be improved as result of reduction in such discharges. These improvements will be effected within and outside the O'Hare Facility Area regardless of the plant location. Thus, for the ultimate condition, it can be assumed that one site would be no more or no less advantageous than another in terms of impact on water quality.

On the otherhand, if the plant is to be relocated from the presently proposed Site No. 1, there will be substantial project delays extending up to maximum of 5 years depending on the particular alternate site selected. During this delay, more combined sewage overflow will be discharged to the streams, frequency of basement flooding will be greater, and the probability of North Side Plant becoming overloaded will be increased. Therefore, in terms of environmental impact in the near future, all sites must be graded negatively in the matrix except Site No. 1.

Collectively, that is considering the near future and the ultimate conditions, only Site No. 1 can be assigned the most beneficial rating.

B. Air Quality:

Before proceeding with the discussion of impact on air quality at the various sites, several pertinent comments are in order.

First, the MSDGC firmly believes that the proposed O'Hare WRP will in no way adversely affect the air quality surrounding the plant site. This implies that aerosols generated by the plant will not pose any health hazard to the people residing or working near the plant.

If there was an objectionable emission, it would be necessary to determine its effect upon some impacted area. To assess the environmental effects of an air pollution source, the impacted area must be defined. What are the dimensions and geometry of an impacted area? Considering the sources and types of imaginary air pollutants, it is the opinion of the MSDGC that the impacted area is limited to a zone immediately adjacent to the plant and within 500 feet of its boundaries.

Since the baseline assumption is that the O'Hare WRP is allegedly an air pollution source, every site is assigned a negative environmental impact rating. However, Sites No. 4, No. 5 and No. 9 are rated as having a severely adverse impact because of their proximity to a large number of people either residing or working in the adjacent area (within 500 feet of plant boundaries).

A plant relocated to Site No. 4 would displace all of the Oasis Mobile Home Park and the northern half of Lehman's

Trailer Park and the Touhy Mobile Home Park. The remaining portion of latter two mobile parks would accomodate approximately 1,000 people. Nearly half of these people would be residing within the 500 feet limits of the plant.

A plant relocated on Site No. 9 would be surrounded predominately by light industry buildings. Most of these buildings appear to be used for combination of office, warehouse and production purposes. Excluding a plant owned by Halo Lighting, approximately 600 persons would be situated in the impacted area. In addition to the 600, another 1200 employees of the Halo Lighting Company would be located in the impacted area if the O'Hare WRP could be located on land adjacent to, but not occupied by the Halo Plant. If Halo Lighting Company is displaced from the site, the obvious first effect would be to displace 1200 persons, but a secondary effect would be to reduce the number of people in the impacted area to about 600. In summary, the potential number of people affected by locating the plant at Site No. 9 is in the range of 600 to 1800.

A plant relocated to Site No. 5 could affect the employees of Halo Lighting and SDK Industrial Park as well as the people residing in the residential area located southeast of Site No. 5. The number of people affected would vary considerably depending on how and where the plant is located within the site. Potentially, the range of number of people affected varies from 200 to 1400.

Site No. 1, although adjacent to a residential area, does not affect as many people within the assumed impacted area as sites No. 4, No. 5 or No. 9. Within the impacted area there are approximately 50 homes and two medium size industrial complexes. The number of people affected at Site No. 1 is therefore estimated to be less than 300.

C. Noise!

Noise generated by routine plant operation will be attenuated by use of acoustical building materials and mechanical devices. Noise will be minimized to the extent that it will not be detectable beyond the plant limits. Hence, the site selection process is not affected by consideration of noise as an impact on the environment.

D. Visual Effect on the Surrounding Area:

The proposed O'Hare WRP is designed to have an aesthetically pleasing appearance. The four main buildings will have an earthy brownish brick facing mixed with glass and precast architectural concrete. Areas exposed to the public will be architecturally landscaped. In general, the plant complex will be similar in appearance to many office parks or light manufacturing buildings found in the surrounding areas. Since all of the sites considered, are adjacent to areas zoned for light industry, the plant is visually well suited for placement in any of the sites considered. Thus, site selection process is not influenced to any substantial degree by consideration of visual impact on the various sites.

E. Flood Potential:

For any plant site considered it is assumed that the channel located on site will be improved to handle a 100 year storm flow and that channel located downstream of the plant will be improved to carry flow equal to 100 year storm flow plus the maximum plant flow. In addition to improvements to the receiving stream, compensatory storage will be provided for all sites at which it is required. Construction of the plant will in no way aggravate the flood potential conditions which now exist at the sites considered.

In all likelihood, flood potential will be lessened because of the construction of O'Hare WRP. The impact would then be considered as being positive and apply equally to all sites. Furthermore, stream relocation at any of the plant sites considered will not adversely affect the environment.

Summary of Matrix Impacts

SITES

Quality	1	2	3	4	5	6	7	8A	8B	9	10
Water	+2	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1
Air	-1	-1	-1	-2	-2	-1	-1	-1	-1	-2	-1
Noise	0	0	0	0	0	0	0	0	0	0	0
Visual Effect	0	0	0	0	0	0	0	0	0	0	0
Flood Potential	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1	+1
Net Impact	+2	+1	+1	0	0	+1	+1	+1	+1	0	+1

Key:

+2	Highly Beneficial
+1	Above Average Benefits
0	No Effects
-1	Adverse Effects
-2	Severely Adverse Effects

Based on the foregoing subjective assessment it can be concluded that Site 1 is somewhat superior to all other sites considered, but other sites could be environmentally acceptable.

Response to Ward's Criticism on Air Quality

1) Pg. 43 (Slide #19)

If Site No. 4 were selected, and if the O'Hare WRP were located on approximately 65 acres of land the Oasis Mobile Home Park and the northern half of Touhy and Lehman Mobile Home Parks would be displaced leaving about 2500 people homeless. Approximately 1000 people would remain in the impacted area immediately adjacent to the plant.

Mr. Ward's statement regarding Site No. 5 is in error. Within half mile there is a trailer park (Willoway Trailer Park on Oakton) in which an estimated 700 people reside. In addition, residential homes to southeast and west are within the stated distance.

2) Pg. 43 (Slide #20)

The key word here is "relative". It is obvious that Mr. Ward's interpretation of relative does not coincide with that of the MSDGC.

We did not claim that Site No. 5 was surrounded by residential homes only. Out statement read, "... Site No. 5 is surrounded by residential houses and small manufacturing firms on all four sides". This is a fact.

3) Pg. 44 (Slide #21)

Response to this criticism is presented in the environmental matrix description. Basically, our conclusion was that more people would be affected at Site No. 4, because of the mobile home community, and at Site No. 5 because of the concentration of industry surrounding the site.

4) Pg. 44 (Slide #22)

As previously stated in the environmental matrix statement, we have assumed that the impacted area will be adjacent to and within 500 feet of the plant boundaries. In consideration of all the environmental precautions being taken at the plant, we feel that this assumption is reasonable.

ATTACHMENT D

Frequency Of Odor Problems At The O'Hare Water Reclamation Plant

An analysis of the odor potential at the O'Hare Water Reclamation Plant was addressed in Volume 3, Section 2 of the MSDGC's "Public Hearing Documents". This paper was prepared in the response to public testimony received on the draft document entitled "Environmental Assessment Statements For Proposed Projects For The Upper Des Plaines Service Basin." The three possible odor generating locations at the plant and the methods which will be used to contain and neutralize these conditions were discussed in pages 14 to 19 of the odor control section of the report.

Previously, Mr. Lynam, in a letter to Mr. Richard F. Ward, dated March 26, 1973, discussed the reliability of the North Side STW odor complaint survey conducted in February 1973 as well as the nature of the "odor problem" at this plant. A copy of Mr. Lynam's letter is attached.

THE
METROPOLITAN SANITARY DISTRICT
OF GREATER CHICAGO
100 EAST ERIE ST., CHICAGO, ILLINOIS 60611 751-5722

BART T. LYNAM
GENERAL SUPERINTENDENT

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March 26, 1973

Mr. Richard F. Ward
1410 Miami Lane
Des Plaines, Illinois

Ref: Your letter dated February 22, 1973

Subject: O'Hare Water Reclamation Plant Project

Dear Mr. Ward:

Trustee J. Anderson has referred your letter of February 22, 1973 to me for a reply. Before answering the questions posed in your letter, I would like to take this opportunity to commend you for your interest in the O'Hare Water Reclamation Plant (WRP) Project and for your concern for possible odor problems which you feel could be associated with this facility.

The Metropolitan Sanitary District of Greater Chicago (MSDGC) is highly cognizant of its responsibility in minimizing any adverse effects of our operations on the environment. In regard to the O'Hare WRP Project, we have taken all reasonable measures in the design of this facility to insure that the probability of odors emanating from the plant is extremely small.

In answer to your letter, please find the following numbered responses corresponding to the questions you submitted:

1. We have read the results of the February 6, 1973 survey transmitted by your February 8, 1973 memorandum to the MSDGC Board of Trustees. Although we do not question your intent to be objective in the

handling of this survey information, we do know that survey questions of this type can be suggestive and introduce bias into the results.

The development of survey questionnaires is a highly complex task. Organizations which specialize in survey analysis often employ psychologists to assure that the questions employed in the survey are "neutral" and do not tend to lead respondents to offer a desired or undesired reply. It would appear that the question, as posed in your questionnaire, presupposes that an odor problem exists and cannot, therefore, be considered a "neutral" query. The validity of results obtained from such a question is, at best, dubious.

2. A well operated aeration tank does not emit obnoxious odors. The MSDGC is well known for its excellence in maintaining and operating its treatment facilities. Additionally, back-up systems are provided for electrical power and critical mechanical equipment to insure continuous plant operations. Therefore, the aeration tanks do not constitute a problem area.

3. You have asked what specific steps the MSDGC will take to eliminate the "odor problem" at the North Side STW. The District does not consider that an "odor problem" exists at the North Side STW. However, we can assure you that whenever an odor potential exists, plant operating procedures are immediately instituted to avoid any problems.

4. The specific design differences between the O'Hare WRP and the North Side STW which will reduce the probability of obnoxious odors being emitted are:

   a. All grit, screenings and scum removed from the wastewater will be collected and temporarily stored in covered containers. These operations will be performed in a temperature controlled building and the filled containers will be removed from the plant site on a frequent routine basis.

b. All waste solids generated in the O'Hare WRP will be pumped to the Salt Creek WRP for processing. Processing at the Salt Creek WRP includes solids concentration and heated anaerobic digestion.

5. We shall investigate if there are plants operating in any part of the country which would be comparable to the O'Hare WRP. This information will be transmitted to you when it is available.

In regard to a plant tour of the North Side STW, we will be happy to arrange a tour for any interested group. However, before definite arrangements can be made for the tour, we would like to know the size of the group and at least three (3) alternate dates the group can be available for the tour. We would then extend the invitation to the Mayor and aldermen of the City of Des Plaines, as well as to representatives of the Villages of Arlington Heights, Mount Prospect and Elk Grove Village. Additionally, we would be happy to arrange a meeting with the consultant designing the plant to discuss the plant features.

If I can be of further assistance, please advise.

Very truly yours,

Bart T. Lynam

Bart T. Lynam
General Superintendent

cc: Board of Trustees

bcc: Messrs.
Lynam
Neil
Lue-Hing
Rimkus
Barbolini
Variakojis
Kambara

ATTACHMENT E

Engineering Documents

The engineering documents (plans and specifications) for the first stage, 72 MGD Water Reclamation Plant, for Site 1 are virtually complete. To modify these documents for a different site would entail a considerable amount of engineering time and money depending upon the shape, size and soil conditions of the site. Locating the plant at a different site could involve considerable changes in the relative locations of various plant facilities including major sewage conduits, piping, electrical and other components. Also, complete redesign of foundations may be required depending on the nature of underlying soil.

Need To Proceed With Project

The basic reason to proceed with the construction of the O'Hare WRP is that the sewage originating in the O'Hare Service Area presently flows to the North Side Plant which will become overloaded without the construction of the O'Hare WRP. The annual daily average flows (domestic, industrial, infiltration and rainfall which enters the combined sewer system) for the North Side Plant and O'Hare WRP are as follows: (Assumes North Side STW hydraulic capacity expanded to 500 MGD in 1980).

Year	North Side *(MGD)	O'Hare **(MGD)	Total *(MGD)
	(1)	(2)	(3) = (1)+(2)
1970	291	30	321
1980	319	45	364
1990	331	56	387
2000	344	67	411
2010	350	70	420
2020	356	73	429
2030	362	76	438

*Does not include Egan WRP Service Area flow of 14 MGD which will be diverted from the North Side STW to the Egan WRP in 1975 when Egan WRP goes on-line.

**O'Hare Service Basin flow does not include the 10% reserve capacity.

The North Side Plant is presently a secondary treatment plant with a design capacity of 333 MGD and a hydraulic capacity of 414 MGD. It is estimated that the design capacity of 333 MGD will be reached in about the year 1975.

Another factor delineating the need for proceeding with the construction of the O'Hare WRP is the low ratio of the hydraulic capacity to the design capacity of $1.24 = \frac{(414\ \text{MGD})}{(333\text{MGD})}$ which would exist at the North Side Plant prior to hydraulic expansion. Without either the construction of the O'Hare WRP or the modification of the North Side Plant this ratio will decrease with concomitant deterioration of plant effluent quality.

Another related factor is that the combined pumping and treatment capacity of the North Side and O'Hare plants will be larger than just that of the North Side Plant. Thus, the construction of the O'Hare WRP will result in a decrease in the volume of combined sewer overflow and probability of flooding for both service areas.

Status of Storm Water Reservoir - Site 1

An approximately 65 acre-foot surface runoff storage basin is being provided as a part of the O'Hare WRP. This basin will be located just south of Wille Road on Site 1. The 65 acre-foot volume is made up of the following components: 50 acre-foot of compensatory storage, 10 acre-foot of on-site detention, and 5 acre-foot which is miscellaneous storage.

If the proposed plan of the MSDGC to construct the downstream 2,335 acre-foot Ravenswood Reservoir is successfully implemented, the 65 acre-foot basin on the O'Hare WRP site will be deleted from the O'Hare WRP construction contract.

ATTACHMENT F

THE METROPOLITAN SANITARY DISTRICT OF GREATER CHICAGO

Updating The Cost-Effective Analysis For The O'Hare WRP Alternates

The updating of the cost estimates of the five alternates considered in the December, 1965 "Report on Sewerage for the Northwest Area" would not provide any viable input data because of significant extensive changes that have been subsequently made to the design criteria used as a basis in the report's comparative analysis, and the subsequent IEPA and NIPC approval of the MSDGC separate drainage basin criteria (1).

The major changes in the original criteria are:

1.) The Greeley and Hansen Engineers' 1965 report on on the Northwest area alternates is based on reducing the quantity of combined sewage overflow only to the extent of providing 5:1 dilution of raw sewage before discharging to the Des Plaines River and small streams in the Upper Des Plaines and Salt Creek drainage basins (2,3). Under the concept of the TARP program the construction of the Northwest area tunnel storage plan, 72 percent of the volume of combined sewer overflows will be captured for complete treatment at the O'Hare WRP, and the annual average number of spills will be reduced by 92 percent from 80 to less than 6 (4).

The construction of the Northwest Area Tunnel and Reservoir will provide sufficient storage to prevent spills resulting from the maximum rainfall of 21 years of record, and eliminate the backup of sewers into homes, provided local sewer upgrading policy is implemented (5).

2.) The sizing of the activated sludge facilities used in the Greeley and Hansen proposed alternates are based on sludge ages of four days (3). This design criterion is inadequate for achieving nitrification in a single-stage facility. Recent MSDGC pilot plant studies at the West-Southwest STP indicate a minimum SRT of 8-10 days is required for single-stage nitrification.

The O'Hare WRP decision provides for the removal of ammonia nitrogen via a two-stage activated sludge process. The Greeley and Hansen reports do not include any process for meeting the IPCB ammonia nitrogen criteria in any of the five alternates investigated.

3.) No provisions are made for the inclusion of tertiary treatment facilities in the Greeley and Hansen report (6). To meet the IPCB effluent discharge criteria of 4 mg/l BOD and 5 mg/l suspended solids, mixed media tertiary filters are included in the O'Hare WRP design (7).

4.) The Northwest area report recommends the phasing out of the Hanover Park and Streamwood WRP's. The flow from these two plants would be conveyed, via a 72-inch diameter sewer, to one of the five alternate sites (8). The area to be serviced in the Upper Des Plaines Drainage Basin, as proposed in the Greeley and Hansen study, includes those portions of Hanover, Palatine and Wheeling Townships outside of Cook County (9).

Conversely, the Facilities Planning Study recommends a 6 MGD expansion for the Hanover Park WRP (10), and the replacement of the Streamwood WRP with an 84-inch interceptor to the Elgin Main Plant (part of the Elgin Sanitary District) projected for 1978.

> The MSDGC plan of action also differs significantly from the Greeley and Hansen 1965-66 reports in that the proposed defined Upper Des Plaines Drainage Basin for the O'Hare WRP and Northwest area TARP does not extend beyond the Cook County border (11).

Alternates A and B as indicated in the Greeley and Hansen "Report on Sewerage for the Northwest Area" provide sewer conveyance systems to the West-Southwest and Northside Drainage Basins, respectively, for the total flow from the Upper Des Plaines Basin, as defined in the report (12). These alternates violate the MSDGC's separate drainage basin criteria, and could result in a greater frequency of flooding and possible aquatic biota kills from the shifting of significant quantities of flow across natural drainage basins.

For these reasons the MSDGC is of the opinion that the O'Hare Area Facilities Planning Study as revised, January, 1975 adequately reflects the accumulation of planning knowledge and forethought used to formulate the present status of the O'Hare Water Reclamation Plant.

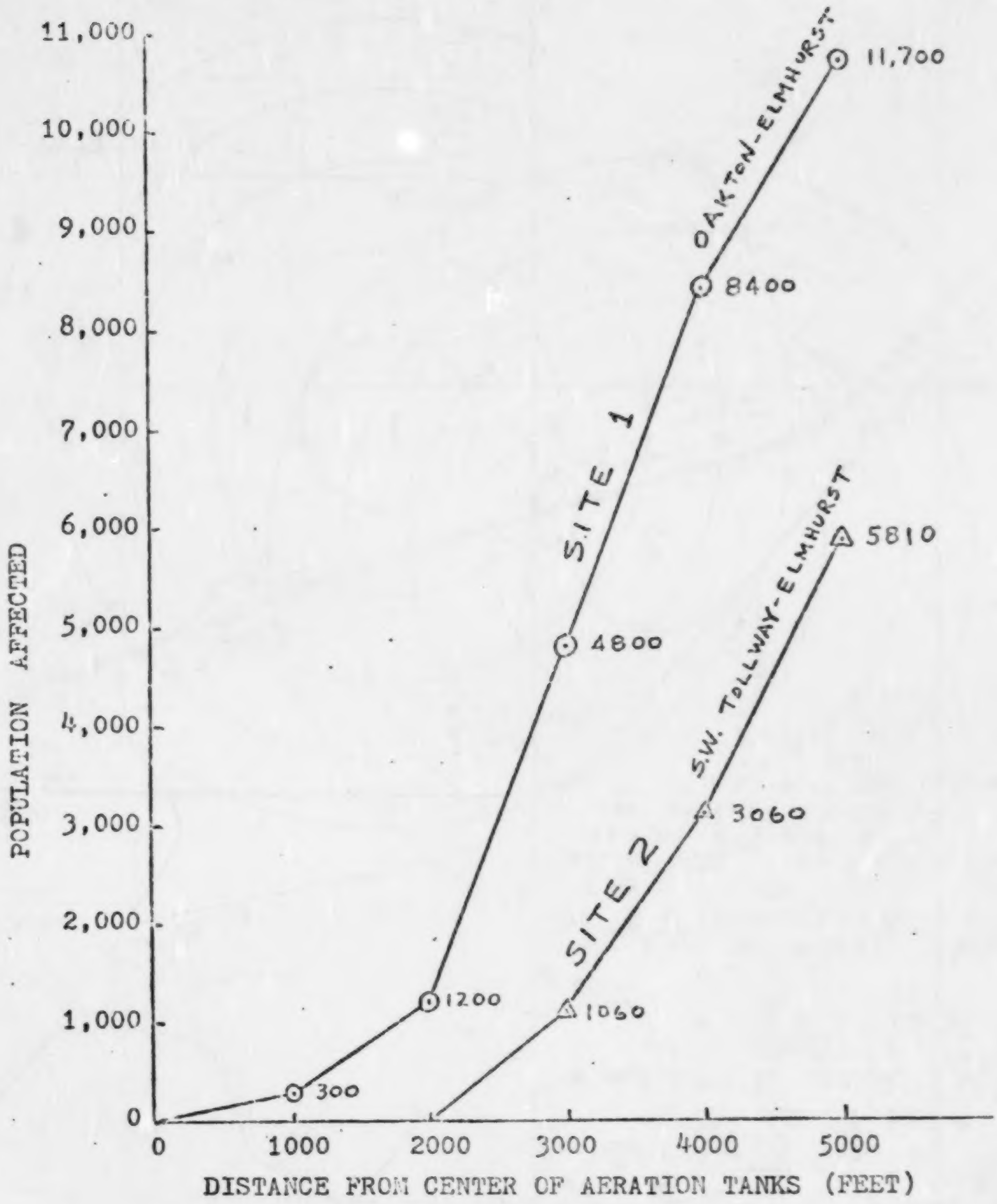
Any additional delays in reevaluating previously studied and rejected alternates encumbers an additional financial burden of approximately $1.0 million per month delayed (13). This value represents the sum of the effects on environmental and social inventory of inadequately treated sewage effluent and the inflationary escalation of sewage treatment plant construction costs. The erosion of the purchasing power of the MSDGC Construction Bond Fund, also due to these inflationary pressures, aggravates the effect of this financial burden, and hinders the MSDGC in discharging its responsibility of protecting the environment.

Footnotes

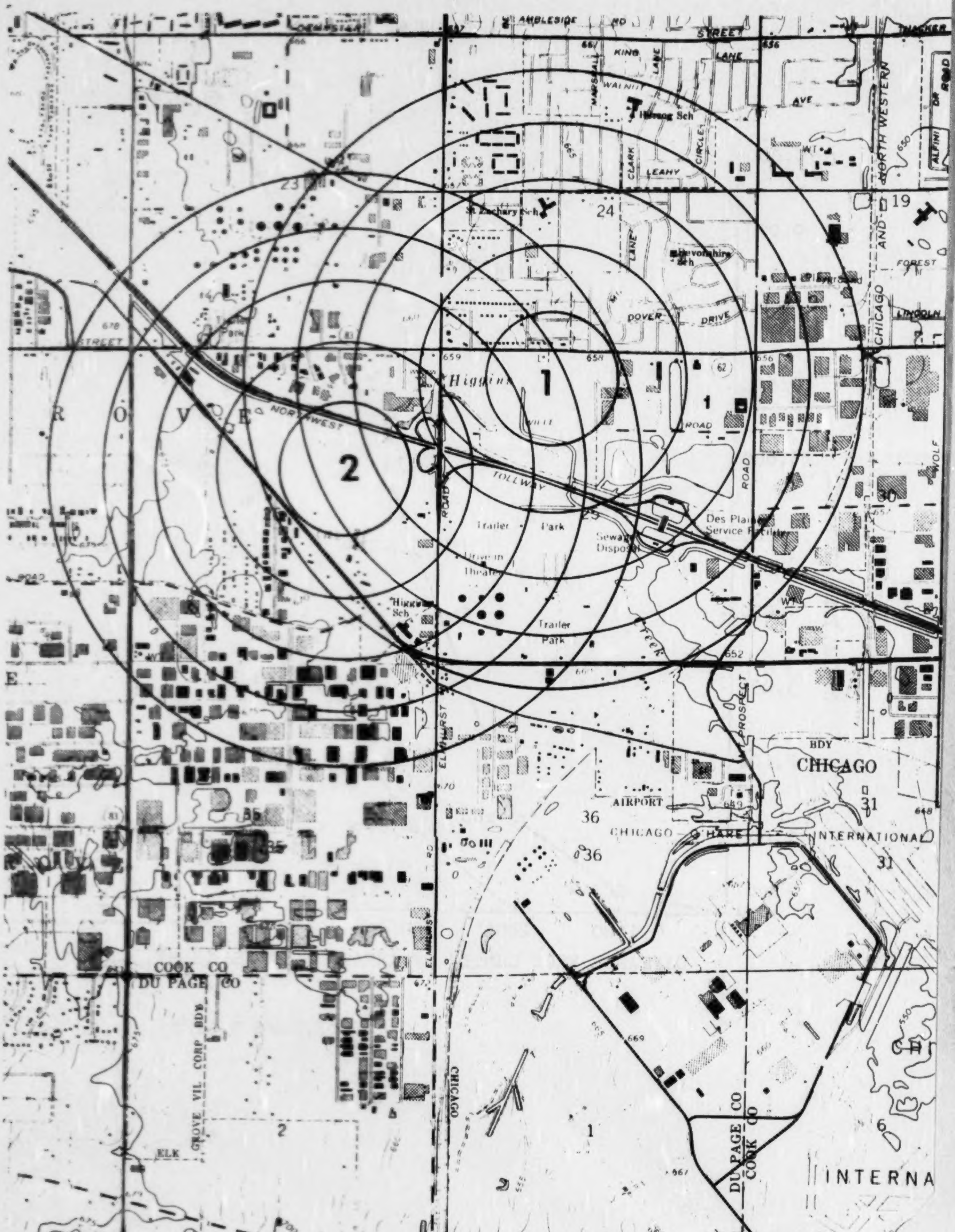
1. Letter from Dr. Richard Briceland to Pres. John Egan, September 6, 1974.
2. Report on Sewerage for the Northwest Area, prepared by Greeley and Hansen Engineers, August, 1965, revised December 20, 1965, p. 17.
3. Summary of Recommendations In Greeley and Hansen Reports Submitted to the MSDGC 1965-66, p.i.
4. Environmental Assessment Statements For Proposed Projects For The Upper Des Plaines Basin, prepared by Consoer, Townsend and Associates, November, 1974, p.S-3, 4.
5. Preliminary Plans for O'Hare Collection Facility, prepared by DeLeuw, Cather and Company, November, 1972, p.V-4.
6. Report on Sewage for the Northwest Area, p. 18.
7. Facilities Planning Study, O'Hare Facility Area, revised January, 1975, p. OA-C-4.
8. Report on Sewage for the Northwest Area, fig. 5-9, and p. 7-12.
9. Ibid., p. 3.
10. Facilities Planning Study, Hanover Facility Area, revised January, 1975, p. H-X-1
11. Environmental Assessment Statement For The O'Hare Water Reclamation Plant, prepared by Consoer, Townsend and Associates, November, 1974, p. I-2.
12. Report on Sewage for the Northwest Area, p. 7-10.

13. Based on an overall construction cost estimate of $197,010,000 (including the O'Hare WRP, Upper Des Plaines Tunnels 20,20A,20B,20C,21, and 22, and the Northwest-O'Hare Reservoir), and an annual average inflation factor of 6%.

APPENDIX R



R.F.Ward 3/12/75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CHICAGO AND
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DOVER
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FOREST
LINCOLN
Playground
STREET
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Higgins
NORTHWEST
TOLLWAY
ROAD
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Trailer Park
Drive In Theater
Sewage Disposal
Des Plaines Service Facility
25
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WOLF
Higgins Sch
Trailer Park
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BDY
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AIRPORT
CHICAGO O'HARE INTERNATIONAL
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SITE SELECTION

Value Judgements

5	Excellent
4	Good
3	Fair
2	Poor
1	Very Poor

		Aesthetically Remote		Emission Control		Cost		Total
		Value	Weight 5 x	Value	Weight 4 x	Value	Weight 3 x	
Expand Salt Creek Plant and interconnect NW and Des Plaines Tunnels		4	20	4	16	5	15	51
Airport Sites 1 & 2 Centex Site 3	Uncovered	5	25	1	4	5	15	44
	Covered	5	25	4	16	3	9	50
	Underground	5	25	4	16	1	3	44
Southeast of Higgins and Busse Site 5	Uncovered	4	20	1	4	5	15	39
	Covered	4	20	4	16	3	9	45
	Underground	4	20	4	16	1	3	39
Southwest of Mt. Prospect and Touhy Site 4	Uncovered	4	20	1	4	4	12	36
	Covered	4	20	4	16	2	6	42
	Underground	4	20	4	16	1	3	39
Southwest of Tollway and Elmhurst. and Ravenswood Airport site	Uncovered	3	15	1	4	5	15	34
	Covered	3	15	4	16	3	9	40
	Underground	3	15	4	16	1	3	34
Oakton and Elmhurst	Uncovered	1	5	1	4	5	15	24
	Covered	1	5	4	16	3	9	30
	Underground	1	5	4	16	1	3	24
	Uncovered							
	Covered							
	Underground							

The above represents our local value judgements and weights.

It is requested that each member of the EIS team fill in his or her own values and weights and add any other factors that each individual feels would be professionally relevant.

R. F. Ward 2/13/75

APPENDIX S

Aerosols have been defined as particles in the size range of 0.01-50 (microns) suspended in air (Magill, et el., 1956). Much of the reported work with biological aerosols has centered on the study of coliform bacteria that have been the traditional indicators of domestic fecal water pollution.

The first study of bacteria emitted to the atmosphere by sewage disposal processes was that by Fair and Wells (1934), who concluded that respitatory and skin disease organisms could remain airborn and viable for long periods. In 1955, A. H. Woodcock described "the bubble-jet-droplet mechanism" of aerosol formation under most atmospheric conditions, a droplet will evaporate quickly, thus leaving the materials that were suspended or dissolved in the droplet as a solid particle in the air. The solid particles left suspended in the air will settle very slowly because of their small size (usually less than 10 to 15 microns) and flocculent nature.

Ledbetter and Randall (1965) reported that the number of recovered coliforms above background increases linearly with wind velocity, when measured at a constant 20-foot distance, and decreases asymototically with distance downwind, and falls off severely at relative humidity readings below 55%. Poon (1966) also found E. coli to have an extremely short life span in aerosol form.

Randall and Ledbetter (1966) showed the bacterial population of air is significantly increased by passage over an activated sludge waste treatment unit, from about 8 per cubic foot on the upwind side to 1,170 per cubic foot on the downwind side. Despite a rapid die-off of bacteria during the first 3 seconds they are airborne, the increase in bacterial population persisted for a considerable time and distance. The distance was strongly dependent on the wind velocity.

They also found that pathogenic bacteria of the genus Klebsiella, formed a large capsule which apparently protects the organism from desiccation in flight. The most significant aspect of this observation is that all species of this genus are known pathogens of the respiratory tract. This differentiation demonstrates the need for specific testing of Klebsiella and other specific pathogens in biological aerosols from wastewater studies in lieu of the more traditional general coliform group. Spendlove (1957) found production of bacterial aerosols in a rendering plant process and recovered airborne organisms downwind from the plant. Bacterial air pollution associated with a sewage treatment plant utilizing trickling filters for secondary treatment was investigated by Albrecht (1958). He was able to recover coliforms up to fifty feet downwind of a high-rate filter. He also found that distance of travel from the trickling filter source was proportional to wind velocity. Napolitano and Rowe (1966) reported that the activated sludge process liberates ten times as many airborne coliforms as the trickling filter. A similar relation was reported by Ladd (1966). Adams and Spendlove (1970) found coliforms emitted from a trickling-filter sewage treatment plant at a distance 0.8 miles downwind from the source. This was the largest distance sampled. Higgins (1964) brought the wastewater bursting bubble phenomenon into the laboratory. He observed that aerosolization is decreased by detergents, and that many droplets are too small for the jet droplet mechanism responsible for much bursting bubble aerosolization. He found a very low recovery of coliforms (no E. coli) in comparison to Serratia marcescens, Bacillus subtilis, and Streptococcus spp. He then determined that there occurs within the liquid a migration of S. marcescens toward the surface, and of coliforms away from the surface, thus affecting aerosolization rates. This finding should be borne in mind in considering coliforms as indicators for bursting-bubble-based air pollution.

A dispersion model was developed to relate airborne bacterial concentrations to the rate of bacterial emission by Kenline (1968). He studied the number and types of bacteria emitted from an activated sludge sewage treatment plant and two extended aeration treatment plants. The dispersion model accounted for the depletion of the bacterial cloud by atmospheric diffusion, deposition, and die-off. The predominant size range of the bacteria was 3 to 6 microns. The average emission rate of bacteria from the aeration tank was 440 bacteria/sq.m/second.

In general, it can be concluded that bacterial aerosols remain viable and travel further with increased wind velocity, increased relative humidity, lower temperatures, and darkness. The fact that aerosols are generated cannot be disputed. Aside from the environmental factors considered to this point, a considerable amount of work has been done on the effect of other environmental factors and their impact on the survival of bacterial and viral aerosol particles.

Resistance to aerosol stress is highly dependent on species and life cycle stage. Klebsiella propably owes much of its resistance to its polysaccharide capsule. Even the effect of varying critical parameters is not the same. For example, lipid-containing viruses are inactivated more rapidly at high relative humidities, while lipid-free viruses are inactivated at low relative humidities (Webb, et. al., 1963). Air pollutants normally present in varying concerntrations are not without their effect on aerosol survival. Won and Ross (1969) found that 3 ppm NO_2 was bactericidal to airborne Rhizobium, especially at 95% relative humidity. Five ppm NO_2 produced a threefold increase in the biological decay rate of VEE virus. Carbon monoxide, (85 ppm, $15^{o}C$), enhanced the inactivation of S. marcescens 4- to 7- fold at lower relative humidity values but was protective under more humid conditions (Lightheart, 1973). Sarcina lutea also exhibited both a protection and a poisoning phenomenon. The author hypothesized that CO uncouples energy-requiring death events as well as maintenance mechanisms. Workers at Porton have reported the presence of a bactericidal factor in the open rural air (Druett & May, 1968). Open night time air results (May et al., 1969) in E. coli decay rates of 3 to 10% per minute as opposed to laboratory air values under 0.2%/minute. The E. coli results were paralleled by those for three viruses: T_7, vaccinia, and Semliki Forest, and five bacteria: S. marcescens, P. tularensis, Brucella suis, Staph epidermidie, and group C. Streptococcus, B.S. niger spores and Micrococcus radiodurans were resistant. This is important when one considers the proximity of man and animals to sewage effluent. The inhalation of bacteria was studied and it was determined that adjacent to an activated sludge aeration plant approximately 40 percent of the biological aerosols penetrated the lungs and approximately six percent penetrated the alveoli (Randall and Ledbetter, 1966). These precentages increased to 60 and 13 percent, respectively, 20 feet downwind from the tank as the droplet size decreased due to desiccation.

It is also important to consider the potential protective or lethal effects of chemicals in sewage on biological aerosols. Zentner (1966) demonstrated that the presence of both organic and inorganic compounds of a specific nature prolonged the survival of aerosolized Serratia marcescens in air (relative humidity 40 percent). These chemicals evidently protect or stabilize the organisms against desiccation and oxidation. Ledbetter (1964) states that in sewage aerosols high evaporation rates produce nuclei of solid waste which were originally dissolved or suspended in the biological aerosols. It would appear likely that these solid waste nuclei may surround or coat the microbes within the desiccated droplet. Atmospheric bacterial die-off is geometric in nature, with the majority of the organisms dying within three seconds. The remaining resistant bacteria, protected by chemical additives which inhibit evaporation, continue to die at a decreasing rate with time (Adam and Spendlove, 1970 ; Randall and Ledbetter, 1966; Poon, 1968). This observation has a great effect on which methods of analysis and what specific bacteria should be determined in assessing the pathogenesis of biological aerosols.

It is not known if the chemicals in sewage enhance the infectivity on biological aerosols by synergistic effects. To the contary, it would seem likely that, if chlorine were present in combined form (e.g. chloramines), then lethality to micro-organisms might even be enhanced because of the close and prolonged proximity of the disinfecting species to the microbes following desiccation.

Even more uncertain are the processes of the infection machanism once contaminated aerosols are inhaled by humans. Because little is known of the minimum infecting dose of most organisms, little can be concluded from a public health standpoint.

The infectious process is indeed complicated and almost innumerable variables must be considered. A range of from one to many thousands of infectious organisms may be required to produce a disease state. Authorities have observed that sewage effluent is not particularly hazardous to sewage plant workers or people associated with sewage irrigation sites (Herzik, 1958 and Wells, 1961). In fact, as a group, sewage workers may have less sick days than the general population. Melnick (1967) suggested that sewage workers were possibly immunized by their exposure to small amounts of infectious organisms.

Dowling (1966) questions what would happen to our immunity if we breathed in no micro-organisms over long time periods. He cites the experience with measles in isolated populations and also poliomyelitis in advanced countries. Immunization by inhalation of small quantities of pathogens may protect us from disease. Additional studies in the United States have demonstrated that local inhabitants of certain areas with inadequately treated water may have low case rates of gastroenteritis, while visitors and newcomers to the area have considerably higher case rates. This could be due to differences in immunity to indigenous waterborne microbial populations. A similar situation is often evident among travelers to foreign countries. Americans often get gastroenteritis in travels to Latin American countries, where food and water sanitation is often not as extensive as in the United States. The permanent populations appear unaffected by the same water and food. Again the probable difference is that the local populations have received prolonged small and even infective immunizing doses (but no disease-producing) of the organisms that stress the visitors. Therefore, it is not adequate to compare "sewage workers" to individuals in the general population who may come into sporadic contact with infectious agents in sewage aerosols or on vegatation and soil. It is necessary to explore the survival of all pathogenic microbes in raw or inadequately disinfected but treated sewage, at least until such time as a substantial epidemiologic study may prove the harmlessness of these organisms in this context.

In summary, it can be seen that there are innumerable factors which control the viability and infection potential of micro-organisms commonly found in wastewater aerosols. To conclude that the presence of these aerosols will positively result in a public health hazard is not supported by scientific evidence. Conversely, it has not been proven that there is no possibility that such aerosols have any public health impact. There is simply no epidemiological data available, of which we are aware, that would indicate any public health impacts whatsoever. Given this tremendous gap in evidence, we cannot, at this time, conclude that the aerosols generated at the O'Hare Water Reclamation Plant will have any significant adverse impact. This is by no means a closed case. Should such evidence become available, we would find it imperative to require mitigative remedies necessary to eliminate any public health hazard as well as implement compliance with any law applicable. Because of the interest in this particular subject, we have also included MSDGC's position paper with respect to health aspects in Appendix I.

APPENDIX T

WATER QUALITY DATA OF WELLER'S CREEK*
COMPARED TO STATE STANDARDS**

Weller's Creek	Unit	State Standards
Water		
Temperature (F°)		
Number of Analyses	10	The maximum temperature rise above natural temperature shall not exceed 5°F. January 60° F. maximum August 90° F. maximum
Maximum Value	75	
Minimum Value	36	
Average Value	55	
Field Dissolved Oxygen (mg/l)		
Number of Analyses	8	Not less than 6.0 mg/l during at least 16 hours of any 24 hour period, nor less than 5.0 mg/l at any time.
Maximum Value	8.5	
Minimum Value	0.0	
Average Value	2.9	
Turbidity (JTU)		No State standards
Number of Analyses	10	Waters shall be free from unnatural sludge or bottom deposits, floating debris, visible oil, odor, unnatural plant or algal growth, or unnatural odor or turbidity.
Maximum Value	800	
Minimum Value	17	
Average Value	102	
Total Solids (Dissolved) (mg/l)		
Number of Analyses	10	1,000 mg/l
Maximum Value	1,309	
Minimum Value	234	
Average Value	701	
Biochemical Oxygen Demand (mg/l)		
Number of Analyses	1	No State standards
Maximum Value	5	
Minimum Value	5	
Average Value	5	

* Water Quality Network, 1971. Summary of Data, Volume 2. State of Illinois Environmental Protection Agency.

** Illinois Pollution Control Board, Rules and Regulations, Chapter 3, Water Pollution. July 1973.

WATER QUALITY DATA OF WELLER'S CREEK
COMPARED TO STATE STANDARDS

Weller's Creek	Unit	State Standards
pH		
Number of Analyses	10	Shall be within the range of 6.5-9.0.
Maximum of Value	8.3	
Minimum of Value	7.3	
Average Value	7.7	
Total Phosphate (mg/1 of PO_4)		
Number of Analyses	10	Phosporus as P shall not exceed 0.05 mg/1.
Maximum Value	4.2	
Minimum Value	0.3	
Average Value	1.7	
Ammonia (mg/1 of N)		
Number of Analyses	5	Shall not exceed 1.5 mg/1.
Maximum Value	3.8	
Minimum Value	0.6	
Average Value	2.1	
Chloride (mg/1)		
Number of Analyses	10	Shall not exceed 500 mg/1.
Maximum Value	395	
Minimum Value	70	
Average Value	181	
Fluoride (mg/1)		
Number of Analyses	7	Shall not exceed 1.4 mg/1.
Maximum Value	0.6	
Minimum Value	0.3	
Average Value	0.4	
Iron (Total) (mg/1)		
Number of Analyses	1	Shall not exceed 1.0 mg/1.
Maximum Value	0.1	
Minimum Value	0.1	
Average Value	0.1	

WATER QUALITY DATA OF WELLER'S CREEK
COMPARED TO STATE STANDARDS

Weller's Creek	Unit	State Standards
Phenols (mg/1)		
Number of Analyses	7	Shall not exceed 0.1 mg/1.
Maximum Value	0.6	
Minimum Value	0.3	
Average Value	0.4	
Sulfate (mg/1)		
Number of Analyses	10	Shall not exceed 500 mg/1.
Maximum Value	215	
Minimum Value	42	
Average Value	99	
Fecal Coliforms (per 100 ml)		
Number of Analyses	10	Based on a minimum of 5 samples taken over not more than a 30 day period, shall not exceed a geometric mean of 200/100 ml nor shall more than 10% of the samples during any 30-day period, exceed 400/ml.
Maximum Value	80,000	
Minimum Value	400	
Average Value	18,180	
Fecal Streptococcus (/100 ml)		
Number of Analyses	3	No State standards
Maximum Value	37,000	
Minimum Value	270	
Average Value	15,090	
Coliform (/100 ml)		
Number of Analyses	5	No State standards
Maximum Value	700,000	
Minimum Value	13,000	
Average Value	188,600	
Chemical Oxygen Demand (mg/1)		
Number of Analyses	10	No State standards
Maximum Value	120	
Minimum Value	22	
Average Value	49	

Water Quality Data 1973 - Summary
Higgins (Willow) Creek at the Des Plaines River

(Units are in mg/l, unless otherwise indicated)

	Water Temp F	Field D.O.	pH Units	Total Phos	Avg BOD-5	COD
No.of Analyses	11	11	11	11		
Maximum Value	73	13.1	8.9	.900		
Minimum Value	32	4.8	7.5	.180		
Mean Value	55	9.0	8.1	.496		
Median Value	56	7.6	8.2	.450		
Criterion	63- 93	5.0	6.5-9	none		

	As	Ba	Cd	Cr HEX	Cr TRI	Cr TOTAL
No.of Analyses	3	3	3	3	3	
Maximum Value	.000	.0	.000	.00	.00	
Minimum Value	.000	.0	.000	.00	.00	
Mean Value	.000	.0	.000	.00	.00	
Median Value	.000	.0	.000	.00	.00	
Criterion	1.000	5.0	.050	.05	1.00	

	TDS/EC	Fluor	Chlor	Sulft	Total Sulfr	Boron
No.of Analyses	11	3	3	3		3
Maximum Value	670	.4	130	140		.3
Minimum Value	230	.3	70	84		.2
Mean Value	559	.3	98	103		.2
Median Value	600	.3	95	86		.3
Criterion	1000	1.4	500	500		1.0

	Phenol	Cu	OIL	MBAS	CCE	TURBY #UNITS
No.of Analyses	11	3		11		
Maximum Value	.005	.000		1.50		
Minimum Value	.000	.000		.40		
Mean Value	.001	.000		.65		
Median Value	.000	.000		.60		
Criterion	.100	.250		None		

Water Quality Data 1973 - Summary
Higgins (Willow) Creek at the Des Plaines River

(Units are in mg/l, unless otherwise indicated)

	FEC COLI No./100ml.	AMM N	NTRAT+ NTRIT	ORG N	TOTAL N	TSS
No. of Analyses	11	11	11			
Maximum Value	20000	.90	1.5			
Minimum Value	100	.05	.0			
Mean Value	659	.28	.8			
Median Value	510	.21	1.0			
Criterion	200	1.50	None			

	Cu	Pb	Mn	Ni	Ag	Zn
No. of Analyses	3	3	3	3	3	3
Maximum Value	.11	.10	.15	.0	.000	.1
Minimum Value	.05	.02	.05	.0	.000	.0
Mean Value	.08	.05	.11	.0	.000	.0
Median Value	.10	.05	.13	.0	.000	.0
Criterion	.02	.10	1.00	1.0	.005	1.0

	Fe TOTAL	Fe DISS	Hg µg/l	Se	PLNKTN NO/	COLOR UNITS
No. of Analyses	3		3	3		
Maximum Value	.6		.2	.00		
Minimum Value	.2		.0	.00		
Mean Value	.3		.0	.00		
Median Value	.3		.0	.00		
Criterion	1.0		.5	1.00		

Water Quality Data 1974 - Summary
Higgins (Willow) Creek at the Des Plaines River

(Units are in mg/l, unless otherwise indicated)

	Water Temp F	Field DO	pH Units	Total Phos	Avg BOD-5	COD
No. of Analyses	7	7	7	7		
Maximum Value	72	19.7	8.6	.600		
Minimum Value	33	9.7	8.0	.200		
Mean Value	48	12.7	8.3	.350		
Median Value	42	12.2	8.3	.300		
Criterion	63-93	5.0	6.5-9	None		

	As	Ba	Cd	Cr Hex	Cr Tri	Cr Total
No. of Analyses	2	2	2	2	2	
Maximum Value	.0	.0	.00	.00	.0	
Minimum Value	.0	.0	.00	.00	.0	
Mean Value	.0	.0	.00	.00	.0	
Median Value	.0	.0	.00	.00	.0	
Criterion	1.0	5.0	.05	.05	1.0	

	TDS/EC	Fluor	Chlor	Sulft	Total Sulfr	Boron
No. of Analyses	6	2	2	2		2
Maximum Value	810	.5	100	120		.3
Minimum Value	410	.3	65	93		.2
Mean Value	603	.4	82	106		.2
Median Value	615	.4	82	106		.2
Criterion	1000	1.4	500	500		1.0

	Phenol	Cn	Oil	MBAS	CCE	Turby #Units
No. of Analyses	7	1		7		
Maximum Value	.006	.00		.60		
Minimum Value	.000	.00		.40		
Mean Value	.001	.00		.47		
Median Value	.000	.00		.40		
Criterion	.100	.25		None		

Water Quality Data 1974 - Summary
Higgins (Willow) Creek at the Des Plaines River

(Units are in mg/l, unless otherwise indicated)

	FEC COL. No./100 ml.	AMM N	NTRATE+ NTRIT	ORG N	TOTAL N	TSS
No. of Analyses	7	7	7			
Maximum Value	3500	0.75	1.8			
Minimum Value	100	0.08	0.1			
Mean Value	881	0.28	1.0			
Median Value	1100	0.25	1.1			
Criterion	200	1.50	None			

	Cu	Pb	Mn	Ni	Ag	Zn
No. of Analyses	2	2	2	2	2	2
Maximum Value	.10	.09	.09	.0	.000	.0
Minimum Value	.00	.05	.09	.0	.000	.0
Mean Value	.05	.07	.09	.0	.000	.0
Median Value	.05	.07	.09	.0	.000	.0
Criterion	.02	.10	1.00	1.0	.005	1.0

	Fe TOTAL	Fe DISS	Hg µg/l	Se	PLNKTN NO/ML	COLOR UNITS
No. of Analyses	2		2	2		
Maximum Value	1.3		.3	.0		
Minimum Value	0.6		.0	.0		
Mean Value	0.9		.1	.0		
Median Value	0.9		.1	.0		
Criterion	1.0		.5	1.0		

APPENDIX U

Recommended Standards

for

SEWAGE WORKS

Great Lakes-Upper Mississippi River

Board Of State Sanitary Engineers

ILLINOIS
INDIANA
IOWA
MICHIGAN
MINNESOTA
MISSOURI
NEW YORK
OHIO
PENNSYLVANIA
WISCONSIN

1971
REVISED
EDITION

CHAPTER 40

SEWAGE TREATMENT WORKS

Treatment, the extent of which will depend upon local conditions, shall be provided in connection with all sewer installations. Primary settling with adequate sludge handling and disposal facilities shall be the minimum degree of treatment. The engineer should confer with the reviewing authority before proceeding with the design of detailed plans. The engineering report and preliminary plan should include plant site selection.

Ordinarily sewage treatment plants should be designed to provide for the estimated population 15 to 25 years hence, under normal growth conditions. All plants should be designed so they can be readily increased in capacity except where circumstances preclude the probability of expansion. Expansion by modular steps should be considered.

The following items should be taken into consideration in planning sewage treatment works:

41. Plant Location

In general, to avoid local objections, a sewage treatment plant site should be as far as practicable from any present built-up area or any area which will probably be built up within a reasonable future period. The direction of the prevailing winds should be considered when selecting the plant site. If a critical location must be used, special consideration must be given to the design and type of plant provided. Plants shall be located at an elevation which is not subject to flooding or otherwise be adequately protected against flood damage. The plant should be readily accessible in all seasons. The site should be of ample size to accommodate expansion and for addition of facilities to increase the degree of treatment.

42. Quality Of Effluent

The required degree of treatment for sewage treatment plants shall be based on the Water Quality Standards and objectives for the receiving waters as established by the responsible state agency. The selection of the type of treatment process involved must be such as to meet these requirements.

APPENDIX V

March 25, 1975

Commissioner William E. Downes, Jr.
Department of Aviation
City of Chicago
Room 1111 - City Hall
Chicago, Illinois 60602

Dear Mr. Downes:

As you may know, this Agency is presently preparing an Environmental Impact Statement on the proposed O'Hare-Des Plaines Water Reclamation Plant for which the Metropolitan Sanitary District of Greater Chicago is seeking grant assistance under P.L. 92-500. The treatment facility is to serve all or part of the following communities: Arlington Heights, Buffalo Grove, Des Plaines, Elk Grove, Mount Prospect, Prospect Heights, Rolling Meadows and Wheeling.

Our regulations require that we consider alternate sites for all projects involving construction. Furthermore, our analysis of alternate sites must take into account engineering, environmental, economic and social factors. One of the nine sites considered for the Water Reclamation Plant was the O'Hare Airport Maintenance Expansion Area. In 1966, your Department indicated that this site was not available. Since that time, this site has been considered for a MSDGC stormwater retention reservoir with the approval of the Department of Aviation.

In order that we may document our consideration of this proposed site we would appreciate learning of the status of this site, your future plans for it, if any, and any reasons why the site would be acceptable for a stormwater reservoir but not a water reclamation facility.

We appreciate your assistance in this matter. Should you have any questions or need additional information, please contact this office.

Sincerely yours,

CONCURRENCES

	Harlan D. Hirt Chief, Planning Branch			

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CITY OF CHICAGO

DEPARTMENT OF AVIATION

Room 1111, City Hall · Chicago, Illinois 60602

RICHARD J. DALEY
Mayor

WILLIAM E. DOWNES, JR.
Commissioner

May 8, 1975

ENVIRONMENTAL PROTECTION AGENCY
RECEIVED
MAY 09 1975
PLANNING BRANCH - Region V
FILE NO. ____________

Mr. Harlan D. Hirt
Chief, Planning Branch
United States Environmental
Protection Agency
230 South Dearborn Street
Chicago, Illinois 60604

Chicago-O'Hare International Airport
Proposed O'Hare-Des Plaines Water
Reclamation Plant

Dear Mr. Hirt:

On March 25, 1975, you wrote to me regarding the proposed O'Hare-Des Plaines Water Reclamation Plant which the Metropolitan Sanitary District of Greater Chicago has programmed for construction.

We have been in contact with the Metropolitan Sanitary District on and off for a number of years, as recalled in your letter. We have explored any number of ways whereby the siting of the proposed plant could be accommodated on airport property. Each time I have been obliged to reiterate the Department's position that no accommodation for this plant may be made.

The vast majority of airport property has been acquired through Federal Programs. Each of these Grant Agreements contain a condition whereby the city agrees to use land so acquired only for airport or airport related objectives. This provision has forestalled any leasing for lucrative commercial or agricultural purposes, has prohibited us from accommodating other Federal Government projects, and restricted other requests for non-airport purposes.

I hope that this re-statement of our position in regard to the siting of the proposed Water Reclamation Plant satisfies your requirements. Should you have any further question or need additional information, please be assured of my cooperation.

Very truly yours,

William E. Downes, Jr.
Commissioner of Aviation

April 11, 1975

Mr. Joseph Abel
Executive Director
DuPage County Regional
  Planning Commission
421 N. County Farm Road
Wheaton, Illinois 60187

PATON

682 7000

Dear Mr. Abel:

This letter is being sent to follow up a telephone conversation between Sara Wise of this office and Richard Katz of your office regarding a proposal by the Metropolitan Sanitary District of Greater Chicago. We are enclosing copies of the Draft Environmental Impact Statements prepared by this office for the MSDGC proposals.

MSDGC has proposed construction of a Water Reclamation Plant (WRP) for the O'Hare Basin. As proposed, the site would be constructed in Des Plaines, Illinois. Objections to the location of the site at the southeast area of Oakton and Elmhurst Roads have been heard and alternative sites have been suggested.

Alternate #8 per Figure 3-1 (page 3-12) of the enclosed Draft EIS for the WRP was suggested for a number of reasons including industrial location, existence of a receiving stream and an undeveloped site. Please note that site #8 is within DuPage County.

We understand that the Illinois Pollution Control Board has a ruling which determined that the sewage treatment plants in Bensenville and Addison are to be the major facilities located in that portion of DuPage County and that the study completed on Salt Creek by the DuPage County Forest Preserve District, DuPage County Planning Department and Bauer Engineering, entitled "Living With A River In Suburbia" does not indicate the possibility of construction of a new facility. In addition, legal questions arise regarding the authority of the MSDGC to construct a plant in DuPage County.

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Our regulations require that we consider alternate sites for all projects involving construction. Our analysis of alternate sites must take into account engineering, environmental, economic and social factors. In regard to the sites identified as #8 in the enclosed EIS, we would appreciate learning of the status of this site, any future plans for the site and any reasons why your office believes that this site would or would not be a feasible alternate to be considered within the scope of this project.

Any brief comments on this proposal would be appreciated. Thank you for your assistance in this matter.

Sincerely yours,

Harlan D. Hirt
Chief, Planning Branch

Enclosure
a/s